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Crop Diversification Centre South

Annual Report 2004

Alberta
AGRICULTURE, FOOD AND
RURAL DEVELOPMENT

Crop Diversification Centre South
SS 4
Brooks, AB Canada

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70 YEARS STRONG

In 2005 the Crop Diversification Centre South celebrates 70 years of research in horticulture and special crops. Prior to 1935, the Centre was part of the Canadian Pacific Railway (CPR).

We pause to celebrate our past in this Alberta's centennial year. We look to a bright future as we continue to bring innovative ideas and technologies to Alberta's crop producers.

In 1903 the Canadian Pacific Railway owned just over 3 million acres of land in a block between Calgary and Medicine Hat. The company realized that the land would need to be irrigated to meet its full potential. So they set out to build a water delivery system.

The sod was broken for the "Headquarters Farm" in 1918 under the watchful eye of Mr. Augustus Griffin, an experienced irrigation engineer and amateur horticulturist.Later, the first plants were planted on the far, many from the banks of the Red Deer River including 7-15 foot cottonwoods, some which are still standing in Brooks today.

Under Mr. Griffin's 17 years of management, the Headquarters Farm evolved into a nursery foi tree propagation and breeding of native plant materials, and a research centre for all types of horticultural crops.

In the midst of the 1930's the CPR lost $400,000 from the Eastern Section alone, this prompted the decision to suspend the train company's involvement in irrigation. In May 1935, the CPR transferred the first irrigation blocks over to a group of farmers who had formed the Eastern Irrigation District (EID)including the Headquarters Farm. The EID had no idea how to manage the horticultural lands so negotiations began to transfer these lands to the Government of Alberta and/or the University of Alberta.

H.A. Craig the Deputy Minister of Agriculture wrote to the Minister of Agriculture F.G. Grisdale suggesting the government move on the deal. After much controversy 380 acres as well as equipment was turned over to the Alberta Government.

In this memo to the Premier's office dated November 20, 1935, Mr. Craig laid out the plans for the former CPR lands.

> *In May of this year the Canadian Pacific Railway Company presented the Department of Agriculture with a farm, consisting of approximately 380 acres. Over the past eighteen years, the Chief Engineer of the Eastern Irrigation Project, Mr. Griffin, developed a Horticultural Plantation on this area, consisting of tree fruits, bush fruits, small fruits, ornamental shrubs, vegetables, perennials and annual flowers, also wind breaks of various kinds.*
>
> *The object has been to test out varieties of this material which would be most suitable for use by residents of the Province of Alberta. The whole area is irrigated and most of the land is suitable for the purpose.*
>
> *The object of the Department in undertaking this work is to experiment with species and varieties of trees and plants which would be suitable for home planting in the Province. Budding, grafting and crossing work to be undertaken as well. The nurserymen of the Province are anxious to secure budding and grafting material from trees and bushes which are hardy. It is also important that the Department should be in a position to determine which species and varieties are most suitable. Much materials has bee sold to the nurserymen in the past which has been entirely useless and killed during the first winter.*

After 4 different names and one location change, today's Crop Diversification Centre South still is focused on doing research that will help the Agriculture industry in Alberta to grow and prosper.

Industry Shaping Events

1935	Appproximately 32 tons of fruit were picked at the station during the season. 25 tons sold to the Hudson's Bay in Calgary and Edmonton
1943	Alberta produces nearly 47,000 pounds of vegetable seed to respond to worldwide seed need. Seed production contracted to farmers, supervised by Centre Staff
1953	Non-horticultural crops are planted at Centre including hops and field corn
1954	Provincial Horticulture Station relocates to Lendrum farm.
1965	Centre builds the first Filacell cooler in Canada for long term storage of produce
1968	Castle Sweet yellow pepper released from Centre Vegetable Breeding Programs
1970	Brookpack and Brookpact tomatoes released from Centre Vegetable Breeding Programs
1983	Over the row blueberry harvester bought and adapted for harvesting saskatoons
1986	Day neutral strawberries are introduced into Alberta
1991	New production greenhouse build
1992	First 4 year old ginseng is harvested, after surviving 4 years in research plots
1998	Precision delivery system for carbon dioxide developed for greenhouse industry
2002	Fish and plants are being combined in a unique growing closed system called aquaponics, fish waste will be used fertilize the plants, plants will purify the water
2003	Work intensifies on the "health promoting" aspects of fruit, vegetables and herbs.

Crop Diversification Centre South 2004

AGRONOMY RESEARCH

ROSS H. MCKENZIE

The focus of the agronomy research program is to increase production and quality of new and conventional dryland and irrigated crops in Alberta. The program focuses on development of information for producers on nutrient management and agronomic recommendations. Research involves analyzing soil fertility and crop nutrition needs, agronomic needs, developing and designing research protocol, implementing and coordinating research projects, analyzing research results, formulation of crop production models and developing soil fertility, crop nutrient and agronomic recommendations for crops in the various agro-ecological regions of the Alberta.

Research activities are interdisciplinary to examine broader scope interactive agronomic issues of soil fertility and fertilizers with weed populations, herbicide performance, plant disease levels, insect population levels and cropping systems. Field and laboratory experiments are conducted. The research programs involve private industry, federal and provincial researchers. The end results are development of soil fertility, crop nutrition and agronomic information for making recommendations for a wide range of conventional and alternate crops in all major agro-ecological areas in Alberta.

Development of agronomic practices for mustard production

A four-year research project was conducted with funding from Alberta Agricultural Research Institute, Agricore United, Mustard Growers Association, Westco and Agrium. The final report was completed and accepted by AARI. A scientific manuscript was prepared and submitted to the Canadian Journal of Plant Science. The project used three mustard types: Yellow, Brown, Oriental, and one canola variety for comparison. Fertilizer trials included: 5 nitrogen rates with each mustard type, 4 rates of phosphate, 3 rates of potash and 3 rates of sulfate. The agronomy trials included 3 seeding dates each with 5 seeding rates. A total of 20 site years of data was collected.

Malting barley agronomic management

A three-year research project was conducted with funding from Agrium. No other funding agencies supported this project. A scientific manuscript was prepared and submitted to the Canadian Journal of Plant Science. The project used seven malting barley types: Harrington, 2-row: Metcalfe, Kendall, Stratus; 6-row: Excel, B1602, and Sisler. Fertilizer trials included: 5 nitrogen rates with each variety, 4 rates of phosphate, 3 rates of potash and 3 rates of sulfate. The agronomy trials included 3 seeding dates each with 5 seeding rates for Metcalfe and Excel. A total of 12 site years of data has been collected.

Development of agronomic practices for chickpea production

A four-year research project was conducted with funding from Agricore United and the Alberta Pulse Grows Commission. The final report was completed and accepted by AARI. A scientific manuscript was prepared and submitted to the Canadian Journal of Plant Science.. The project used two chickpea types Desi and Kabuli with fertilizer trials including: N fertilizer with and without inoculant, 4 rates of phosphate, 3 rates of potash and 3 rates of sulfate. The agronomy trials included 3 seeding dates each with 5 seeding rates. A total of 20 site years of data has been collected.

Coated N urea management for winter wheat

This project was extended for one additional year. The project is conducted with Agrium to assist in development of new urea coated nitrogen fertilizer. RT Linkages and Ducks Unlimited also fund the three-year study. This project uses AC Tempest winter wheat and seed-places and side banding four rates of urea (46-0-0), Type I (20 day slow release) and Type II (40 day slow release) coated urea. At the end of the project in 2004, there will be 8 site years of data. The project is assessing the effectiveness of the various products. To date, the coated urea, manufactured in Alberta, is working well and is already being marketed in the USA. The 2004 annual report has been completed. Four field days were held at these sites.

To date, the coated urea, manufactured in Alberta, is working well and is already being marketed in the USA.

Agronomic management of winter wheat and winter triticale

This was the second of three-year trial conducted with RT Linkages and Ducks Unlimited. This project uses AC Tempest winter wheat and Bobcat winter triticale. Each crop has two seeding dates with 5 seeding rates, each seeded using both a hoe and disk opener. At the end of the project in 2004, there will be 6 site years of data. The project is assessing the effectiveness of seeding date, seeding rate and low versus high disturbance seeders. The 2004 annual report has been completed. Four field days were held at these sites.

Long-term dryland crop rotation study in the brown soil zone

This was the thirteenth year of a long-term crop rotation study conducted in the Brown soil zone at the Bow Island Substation. The rotations included: continuous wheat, wheat-fallow, wheat-wheat-fallow, wheat-pea, wheat-flax-fallow and grass rotations. Several papers have been published on the long-term effects on soil quality and on the economic benefits of each rotation. No funding is received for this project but the trial continues. An annual project report has been prepared. Two field days were held at this site.

Long-term soil phosphorus and phosphate fertilizer study

This project was terminated in 2003 and was not conducted in 2004 as a result of limited funding. This was the tenth year of a long-term phosphorus fertilizer study conducted in the Brown soil zone at the Bow Island Substation. A second site was terminated at Pincher Creek in 2002. The rotations included continuous wheat and wheat-fallow. Each had a number of different phosphorus management treatments. Without funding the project was terminated in 2003. A final report was written in 2004 after data analysis. A scientific paper remains to be completed.

NEW RESEARCH PROJECTS IN 2004

Irrigated Timothy Production:

A new four year research project was initiated with the Irrigation Branch to conduct irrigation and nutrient management trials with irrigated timothy. Funding is from Alberta Crop Industry Development Fund (ACIDF), Agrium, Westco, Cargill and several timothy hay processors. The nutrient management sites are at Lethbridge (Irrigation Demonstration Farm) and Bow Island (Bow Island Substation) with approximately 30 fertilizer treatments included rates and forms of nitrogen fertilizer, phosphate and potash. The irrigation management trials were established at Bow Island, Rolling Hills and Picture Butte, with four irrigation management levels. Only the Lethbridge nutrient management site was harvested in 2004. All other sites were in the establishment year. An annual report was prepared. One field day was held at the Lethbridge site.

Irrigated Soft White Spring Wheat Production

A three year research project was be initiated in 2004 with funding from Alberta Crop Industry Development Fund (ACIDF) and Agrium The project uses four new soft white spring wheat varieties. Fertilizer trials included: 5 nitrogen rates with each variety, 4 rates of phosphate, 3 rates of potash and 3 rates of sulfate. The agronomy trials included 3 seeding dates each with 5 seeding rates for two varieties. An annual report was completed. A seminar and field day was held with the Alberta Soft Wheat Producers Commission and the Canadian Wheat Board. The project will continue until 2007.

300 people attend the Soil and Crop Diagnostic Field School at the Lethbridge Research Center.

OTHER 2004 RESEARCH ACTIVITIES

Research trials were conducted in conjunction with Dr. L. Dosdall, University of Alberta on the interaction effects of Cabbage Seed Pod weevil damage and nutrient management on canola.

Research trials were conducted in conjunction with Dr. L. Hall, University of Alberta and a Ph.D. graduate student on gene flow transfer in safflower and nutrient management on canola.

Supervised a University of Lethbridge, M.Sc. environmental science graduate student research on a nutrient management research study.

EXTENSION ACTIVITIES IN 2004

Diagnostic field school

CDCS partnered with the Southern Applied Research Association and AAFC - Lethbridge to deliver a Soil and Crop Diagnostic Field School at the Lethbridge Research Center in 2004. The field school focused on three opportunity crops for dryland production in southern Alberta including: winter wheat, mustard and peas. Over 300 people attended.

FRUIT AND VEGETABLE RESEARCH

CHRIS NEESER

THEAN PHEH

MICHELLE WEBBER

The goal of the fruit and vegetable research program at CDCS is to support the expansion of a value added fruit and vegetable industry in Alberta, by providing growers and processors with production knowledge that will lead to a competitive advantage through innovation.

Research covers all aspects of vegetable and fruit production, including post-harvest handling. Most of the projects involve field research, which was done at CDCS, or in some cases, on field sites provided by collaborators. The program also has access to a variety of laboratory, greenhouse and post-harvest facilities. In these projects the common thread is the objective to generate new knowledge that will allow Alberta producers to become more competitive and take advantage of new opportunities.

Research is conducted collaboration with researchers from universities or other government institutions. This enables the fruit and vegetable program to make optimal use of resources and access valuable expertise.

Evaluation of spice crops for dehydration

A pre-feasibility study, prepared for the Processing Investment Attraction Branch by SNC-Lavalin Audet Inc., indicated that a prospective investor would require a supply of 5,000 t of garlic, 2,500 t of onions, 500 t of oregano, 500 t of basil and 300 t of parsley. Such a dehydration plant would provide significant diversification opportunities for a substantial number of growers.

From an agronomic standpoint the most important question is to determine whether suitable cultivars can be grown that will achieve high yields and meet quality standards. There is considerable genetic variability in all of these crops, which ultimately will determine their economic viability. The goal was to identify appropriate cultivars on the basis of their yield and quality characteristics, when grown under irrigation in southern Alberta. Four varieties of basil, oregano, parsley, and garlic were tested.

Of the three herbs tested, basil and parsley performed best. The highest basil yields were obtained with the cultivars Mammoth, Nufar F1, and Special Select. However, Nufar F1 had the highest leaf to stem ratio. Analysis of the essential oils showed that linalool was the dominant compound in all basil varieties. In the case of parsley the highest yielding variety was Italian, but Forest Green had a slightly higher concentration of apiol, the major component of parsley essential oil.

The direct seeded oregano had very poor germination and produced a very weak stand. Better results were achieved when transplanted, but this is likely too costly to supply a dehydration plant. Finally, as expected the spring planted garlic did not yield as well as the fall planted garlic, but white soft neck varieties can be produced successfully. The best yielding (6t/ha) variety appeared to be a local selection from the Deerfield Hutterite colony.

This work was made possible through a grant from the Industry Development Sector's New Initiatives Fund. We also gratefully acknowledge the garlic seed supplied by Dr. Doug Waterer from the University of Saskatchewan.

Juice yield of selected carrot cultivars

Carrot juice is in growing demand in the beverage industry. Cultivar selection is an important consideration in the production of carrot juice, due to varying quality characteristics and juice yield. Suitable juicing cultivars adapted to Alberta need to be identified. The objective of this study was to compare total yields and juice yields of 15 carrot cultivars suitable for commercial production.

The highest yielding cultivars were Presto, SX3317 CE and Apache, with respectively 135 t/ha, 112 t/ha and 111 t/ha. Whereas the three cultivars with the highest juice content were Presto, Nantes Fancy, and SX3317 CE with juice yields, ranging from 55 % for Presto to 50% for SX3317 CE. Quality parameters, such as sugar content, sugar composition; carotene content and pH have not yet been completed and will be reported at a later date.

As with 2003 yield data showed that early February was the best time for seeding. However, unlike in 2003 the highest yields were obtained with earliest transplanting date, which was April 13.

This trial was conducted in collaboration with Dr. Darcy Driedger (Food Science Laboratory). The carrot cultivars were supplied by Daehnfeldt Inc., Evergro Canada, Harris Moran co., Sakata Inc., Siegers Seeds Co., Sunseeds, and Vilmorin Clause & Co.

Timing of onion transplants

Onions in the Canada #1 Jumbo category (> 3 in. diameter), often referred to as slicing onions, are in high demand. In order to achieve the required size under southern Alberta conditions, such onions have to be grown from transplants. A study was initiated to evaluate the effects of seeding and transplanting dates on onion yield and size; the objective was to determine the optimal timing for seeding and transplanting.

As with 2003 yield data showed that early February was the best time for seeding. However, unlike in 2003 the highest yields were obtained with earliest transplanting date, which was April 13. Both cultivars (Infinity and Mars) produced mostly jumbo-sized onions, but at the latest transplanting date (May 25) 5% of Mars didn't make the Jumbo grade. The cultivar Infinity had fewer single center bulbs, when transplanting was delayed beyond May 13.

Control of nightshade in processing peas

Nightshade is a serious weed problem in processing peas, because it produces toxic berries that are difficult to separate from peas. In southern Alberta there are three annual species of nightshade that are likely to pose a problem. The most common one is hairy nightshade (*Solanum sarrachoides*), followed by black nightshade (*S. nigrum*) and wild tomato (*S. triflorum*), which is also known as cutleaf nightshade.

Managing nightshade can be challenging since the seeds germinate in several flushes throughout the growing season. Furthermore, new seeds are produced within 4-5 weeks, a large portion of which will remain viable in the soil for 5 to 10 years. It is important to take a proactive approach towards the management of this weed.

In 2004 a field study was initiated to compare crop tolerance and weed control efficacy of pre- and postemergence herbicides that could be used in processing peas. The objective was to identify effective herbicides. The treatments consisted of the following pre-emergence (PRE) and post-emergence (POST) herbicides: Gesagard (4.0 l/ha), Gesagard (4.0 l/ha)/ Basagran (2.25 l/ha+ 0.25% Citowet), Gesagard (4.0 l/ha)/Odyssey (42 g/ha + 0.5 % Merge), Dual II Magnum (1.5 l/ha)/Odyssey (42 g/ha+ 0.5 % Merge), Dual II Magnum (1.5 l/ha)/Basagran (2.25 l/ha+ 0.25% Citowet), Basagran (2.25 l/ha+ 0.25% Citowet) and handweeding.

Excellent nightshade control was obtained with all treatments, except when Dual II Magnum was followed with Basagran. This was surprising, since Basagran by itself provided excellent control. Results indicate that Gesagard is a very effective preemergence solution when used alone, but visible crop injury occurred when this product was combined with postemergence treatment of Odyssey or Basagran. Unfortunately, Gesagard (prometryn) is not registered on peas in the United States, and therefore processors have to consider regulations regarding minimum residue levels before allowing the use of this product.

This work was made possible through financial assistance from the Alberta Vegetable Growers (Processing) and through in kind contributions from Lucerne Foods Ltd.

On-farm cabbage cultivar trial

The principal objective of the on-farm cabbage cultivar trial with Sudo Farms Inc., located near Lethbridge was to gain experience in working with growers to develop an alternative strategy for cultivar testing.

In April of 2004 Sudo Farms was provided with seed of eight cabbage cultivars. The grower agreed to handle all production aspects, except harvest and data collection, which would be performed by CDCS staff. This procedure allowed for the generatation of data with about one third of the manpower that would have been required for a typical on-station trial.

If it was necessary to conduct trials on a similar range of crops as done prior to 2002, the cost savings would be reduced due to the inefficiencies inherent of having to operate on several sites. For example, harvest times are likely to overlap, which would require more than one team to collect data. Each team would require a vehicle and an experienced technician to insure that measurements are valid and the data is properly recorded.

Therefore, in order to conduct variety trials involving multiple collaborators and crops, all operations--including data collection--would have to be handled by the growers. The research program's role would have to be limited to coordinate activities, train participants, and compile a report.

Integrated crop management of black currants in Alberta

In 2001 by Prairie Natural Processing Inc. initiated this project in collaboration with the ARC and AAFRD. The role of the fruit and vegetable program at CDCS, was to conduct field experiments at ten black currant orchards to address the following objectives:

- to quantify the performance and development of currently recommended black currant cultivars,
- to compare the effect of mulches on growth performance in different orchards,
- to quantify the response to nitrogen fertilizer, and
- to assess yield benefits of drip irrigation.

In 2004, the final year of this project, yields were far below expectations due to late frost at flowering. The best yielding cultivars were the ones that were slower to flower; Ben Connan and Ben Sarek, with respectively 0.4 kg/bush and 0.3 kg/bush. Like in previous years, there was no beneficial effect on yield from added nitrogen fertiliser, which indicated that existing soil levels were sufficient (50 to 100 kg/ha). Black plastic was beneficial in some cases, but the response was not consistent between varieties and orchards.

Funding for this project was provided by the Alberta Agricultural Research Funding Consortium, Alberta Farm Fresh Producer Association, Alberta Professional Horticultural Growers Congress and Foundation Society, Fruit Growers Society of Alberta, and Prairie Natural Processing Ltd.

Black currant cultivars

Numerous black currant cultivars have been developed in various European countries. However, growing conditions in Europe tend to be quite different from Alberta. Adaptation trials are therefore required to determine the most suitable cultivars. In the May of 2003 a trial was established with nine Russian cultivars not previously tested under our conditions. Four of the nine cultivars tested showed excellent hardiness, good resistance to white pine blister rust and rapid growth. Unfortunately, due to severe frost during flowering, no berries were produced.

The best yielding cultivars were the ones that were slower to flower; Ben Connan and Ben Sarek.

McGinnis Berry Crops Ltd. provided the black currant plants for this trial.

Dwarf sour cherry

The Domestic Fruit Breeding Program at the University of Saskatchewan (U of S) has released a dwarf sour-cherry cultivar suitable for the Prairies. Furthermore, several advanced selections will most likely be released in the near future. The objective of this project is to evaluate winter hardiness and yield performance of some of the advanced dwarf sour cherry selections. In August of 2003, six cultivars were planted in a replicated trial.

In 2004, all of the cultivars planted suffered some degree of winter dieback. In most cases about 40% of the shoots had died. However, due to significant rabbit and deer browsing an accurate evaluation of the severity of the dieback was not always possible. SK Carmine Jewel was the most vigoros of the six cultivars. With an average height of close to 60 cm, it was 10 to 20 cm higher than the other cultivars in the trial. Although no disease problems were observed, some damage to the foliage caused by sawfly larva (*Caliroa* spp.) was apparent. Further observations will be made during the 2005 growing season.

Dr. Robert Bors (U of S, Department of Plant Science) for provided the planting material.

Dwarfing apple rootstock

Modern apple production requires the use of disease resistant dwarfing rootstock that is climatically adapted. Currently the recommended rootstock for the Canadian Prairies is Ottawa #3. However, in many cases this rootstock has proven insufficiently winter hardy. It also appears that it is not the optimal rootstock for the new apple cultivars that are currently being developed at the U of S.

To address this problem two screening trials were established: one in collaboration with the University of Guelph (Dr. John Cline) and one in collaboration with the U of S (Dr. Robert Bors).

Apple cultivars

The U of S has supported a breeding program for Prairie-hardy apples since the early 1940's. In recent years several selections with excellent commercial potential have been identified. In 2003 the fruit and vegetable program began to collaborate with the Domestic Fruit Breeding Program at the U of S to test seven promising selections in plant hardiness zone 3a, with strong Chinook influence. Due to poor grafting success and browsing damage by jackrabbits new grafts had to be made in 2004. By fall most of these new grafts appeared to have taken successfully. All trees were sprayed with a mixture of white latex Thiram to deter browsing by jackrabbits and deer.

Dr. Robert Bors (U of S), graciously provided the necessary scion wood.

Strawberry cultivar testing

In Alberta strawberries are a very important crop to a large number of U-pick operations. The fruit and vegetable program continues to support this industry by screening newly released cultivars and breeding lines for their usefulness in Alberta.

In 2002, planting yields were poor due to what appeared to be a virus infection (and/or calcium deficiency). It is noteworthy that in the 2002 planting cv St-Pierre was high yielding (similar to cv Kent), whereas in the 2003 planting this same cultivar performed very poorly (high winter mortality). The poor performance of this cultivar in the 2003 planting may be related to the quality of the planting material and subsequent slow establishment causing poor winter survival.

The highest yielding cultivar from the 2003 planting was SJ9330-10. This selection was also among the highest yielding ones in the 2002 planting. In previous years this selection has also performed quite well. LL979-46 ranked in fourth place this year, but was the top performer in a trial reported last year. L'Acadie, LL974-23, and LL979-46 reached their maximum yield in the third week of July, and therefore may be used to complement earlier cultivars such as Kent and SJ9330-10.

The collaboration of Dr. Sharokh Kanizadeh, strawberry breeder at the AAFC - St-Jean sur Richelieu, Qc, is gratefully acknowledged.

TECHNOLOGY TRANSFER

Extension activities included:

- Fruit Growers Society of Alberta Field Day, Elnora,
- Prairie Natural Processing Inc. Field Day, Red Deer
- Crop Diversification Centre South, Fruit and Vegetable Field day
- Vegetable Growers Workshop, Lethbridge.

Furthermore, presentations were made at the:

- Alberta Black Currant Network Meeting
- Alberta Vegetable Growers (Processing) Annual Meeting
- Prairie Natural Processing Meeting
- Alberta Berry School
- Fruit Production Workshop, Two-Hills
- Alberta Horticultural Congress
- Olds College (two times).

Contributions were also made to the following newsletters:

- Alberta Farm Fresh Producers Association
- Fruit Growers Society of Alberta
- Prairie Fruit Journal
- Alberta Vegetable Growers (Processing).

GRASS SEED AND FORAGE

HENRY NAJDA

ART KRUGER

The grass seed and forage crops program conducts agronomic and adaptability research to develop and provide information on grass and legume seed production, and on traditional and new forage crops.

Several trials were conducted in cooperation with other research institutions and agencies. These included, the CDCN (grass seed production, bio-fuel) and the ARC - Vegreville (grass seed production).

The following companies and institutions sponsored various research projects in 2004: AAFC; Agricore United (AB); ARC - Vegreville (AB); Barenbrug USA, Inc. (Oregon, USA); Boreal Plant Breeding (Finland); Brett-Young Seeds (MB); Deutsche Saatveredelung (Germany); DLF-Trifolium (Denmark); Miller Seeds (AB); Moore Seed Processors (AB); Northstar Seed Ltd. (MB); Parsons Seeds (ON); Peace Pedigreed Seed (AB); Peace River Seed Co-op Ltd. (AB); Pickseed Canada (ON); Pioneer Hi-Bred Ltd. (ON); Prairie Seeds Ltd. (AB); The Scotts Co. (Oregon, USA); SW Seed Canada Ltd. (SK); Tomorrow's Seed (BC) and Turf-Seed, Inc. (Oregon, USA).

GRASS AND ANNUAL LEGUME SEED PRODUCTION STUDIES

Perennial grass seed production has become a major area of research in southern Alberta. Many seed companies from Canada, the United States and Europe are now contracting both irrigated and rain-fed production acres through out the province.

In 1998 the Western Grass Seed Testing Program (WGST) was founded to provide seed yield and adaptability information to the seed industry. The trials are a cooperative effort of federal and western provincial research and extension staff and the seed industry. Testing sites are located at Fort St. John in BC; Beaverlodge, Bow Island, Brooks and Vegreville in AB; Melfort and Saskatoon in SK and Arborg and Portage La Prairie in MB.

Species currently being tested include Kentucky bluegrass, smooth bromegrass, chewings and creeping red fescue, hard, blue hard, meadow and tall fescue, orchardgrass, perennial ryegrass, timothy and some native species. This program has contributed to increased contract seed production of tall fescue, perennial ryegrass, Kentucky bluegrass and meadow bromegrass, not only in Alberta, but Western Canada also.

The grass seed and forage crops program at CDCS is responsible for seed acquisition and distribution to test cooperators and the production of an annual report for both seed producers and the seed trade. To view this report visit Western Grass Seed Testing Program. < http://www1.agric.

Yields at Bow Island and Brooks were encouraging with some treatments for crimson clover yielding over 1200 kg/ha^{-1}

gov.ab.ca/$department/deptdocs.nsf/all/for7820/$file/wgst_2003_report.pdf?OpenElement>

In 2004, a three-year cooperative project with Dr. S. Acharya with AAFC - Lethbridge and Dr. J. King of the U of A in Edmonton was initiated. The project's goal is to evaluate annual legume species as potential seed crops in Alberta. Funding is through the Alberta Crop Industry Development Fund (ACIDF) and there are four project sites. Three irrigated sites are located at the CDCS substation in Bow Island, at CDCS, Brooks and AAFC - Lethbridge. A rainfed site is located at the U of A in Edmonton.

Annual legume species being evaluated include berseem, rose, Persian, arrowleaf, and crimson clovers and hairy vetch. First year results varied with little or no seed production from any of the species at the Edmonton and Lethbridge locations. Yields at Bow Island and Brooks were somewhat more encouraging with some treatments for crimson clover yielding over 1200 kg ha-1. All species at these two locations produced seed, however crop management will be adjusted for the project's second year, including earlier establishment dates and the use of desiccants in September to facilitate crop harvest.

Western forage testing program

The Western Forage Testing Program (WFT) began in 1995. This is a cooperative tri-province (AB, SK and MB) venture that tests experimental forage cultivars for registration purposes. In most cases, enough location years are incorporated into the testing program to provide a basis for registration and to provide data for particular agro-climatic areas. In 2004, the Alberta Forage Variety Committee (AFVC) supported one cultivar each of alfalfa and meadow bromegrass for registration.

The grass seed and forage crops program at CDCS is responsible for seed acquisition and distribution to test cooperators and the production of an annual report for both seed producers and the seed trade. To view this report visit Western Forage Testing Program. < http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/for7817/$file/wft_2003_report.pdf?OpenElement>

Information from this program is used to update the Agrifax pamphlet Varieties of Perennial Hay and Pasture Crops for Alberta Agdex 120/32 and to update information on Ropin' the Web.

FORAGE AGRONOMY

The grass seed and forage program is participating in a New Initiatives Fund project investigating the biomass and biofuel properties of various species. An irrigated trial was established at Brooks in 2004 and includes grasses like switchgrass, tall fescue and Dahurian wildrye. Some of the objectives of this project are:
•to identify crops that have the potential as dedicated energy or dual crops for biomass production in Alberta
•to establish marker compounds for lignocellulosic content in biomass
•to evaluate the effects of environment on energy content and quality of biomass.

The program leader, H. Najda, provides information services to growers, industry personnel, producer and commodity organizations and other AAFRD staff. In 2004, presentations were made at several industry and producer meetings and provincial advisory committees. A presentation was made at an international conference held in Edmonton. Two information pamphlets on forage variety performance and information on the Ropin' the Web site were updated. The program leader co-authored one scientific publication and wrote several magazine articles.

The program leader participated on the Alberta Forage Variety Committee, the Alberta Alfalfa Seed Committee, the Western Grass Seed Testing Committee, the Western Forage Testing Committee, and the board of directors of the Chinook Applied Research Association.

GREENHOUSE CROPS

NICK SAVIDOV
PATRICIA COTÉ
VIPAN BANSAL
NABEEL MOHAMMED
SCOTT CHAMBO

The greenhouse industry continued growing in 2004 reaching $250 million dollars in total investments and $130 million dollars in gross revenues. The major objective of the Program was to continue serving this fast growing industry by developing and testing new technologies, carrying out extension, organizing workshops and conferences.

The research in 2004 was focused on four areas: studying new substrates as substitutes for sawdust; development of aquaponics as a commercial greenhouse technology; greenhouse crops diversification and plant protection from greenhouse diseases.

The intensive research was mainly financed through a record number of grants from industrial, provincial and federal sources and one large grant from a private partner, and is compliant with the Department Key Initiatives.

Funding sources and in-kind contributors included:
Alberta Crop Industry Development Fund
New Initiative Fund
Aquaculture Collaborative Research and Development Program
Red Hat Cooperative Ltd.
Alberta Greenhouse Growers Assn
Alberta Fish Farmers Association
ARC
ProGerm Systems, Calgary
Air Liquide Canada Inc.
Millenniumsoil Coir, .
ECA Solutions
Argus Control Systems Ltd.
Koppert, Biosphere Technologies
Seair
VG International
MDM Aquafarms
Canwest Compost and Soil Ltd.
Knotty Boyz
Circle M Trout Farm
Western Alfalfa Miling Co. Ltd.
Industrial Mineral Processors
Newlyweds Foods (An Edmonton Nutraceutical Company)
Greiner, Austria, EU
Bear River Zeolites, USA
Nevada Zeolites, USA.

Most projects are carried in collaboration with other programs including aquaculture, food processing, plant pathology, special crops, fruit and vegetables programs and Economics and Competitiveness Sector providing expertise and serving as a research resource in these projects.

The program continued consultations with academic, educational, provincial and federal institutions in Canada and internationally.
- •UN Development Program-Dryland Development Center, Costa Rica
- •University of Virgin Islands, USA
- •University of South Bohemia, Czech Republic
- •Ben-Gurion University, Israel
- •University of Freiburg, Germany
- •Stellenbosch University, South Africa
- •Moscow Timiryazev Agricultural Academy, Russia.

Research trial reports are presented in *Greenhouse Business*, which is also available on the internet.

RESEARCH PROJECTS

Selection of alternative substrates for production of greenhouse vegetables in Alberta

The project, started in 2003. The objectives of the project included the following:
- •Evaluate new greenhouse substrates including coconut fiber and rockwool in comparison with sawdust
- •Evaluate substrates using a zeolite amendment for greenhouse production of cucumbers and peppers
- •Evaluate spent substrates containing zeolite as a fertilizer source with slow release properties for growing container-grown shrubs
- •Provide economic analysis of substrates
- •Transfer the information on the new substrates to growers through workshops and publications.

Experiments with three greenhouse substrates

Four experiments were conducted with two greenhouse crops, bell peppers, cv. Triple4 (red), Bossanova and Sardana (yellow) and Sympathy (orange) and long English cucumbers, cv. Flamingo at CDCS. Sawdust, perlite and coconut fiber (Millenniumsoil Coir) were compared as growth media. The experiments were conducted following commercial standards, three pepper plants per bag and two cucumber plants per bag. The irrigations rates and fertilization did not differ between treatments. The experiments were conducted under full computer control. The irrigation rates were determined by accumulated photosynthetic energy per square cm.

Coconut fiber produced a yield increase from 48.4 to 63.4 kg/m2 or for 22.5% while perlite did not show a consistent yield increase. Coconut fiber showed about 13% increase in yield of two varieties bell peppers including Triple4 (from 13.9 to 16.0 kg/m2) and Sardana (from 17.07 to 20.27 kg/m2) compared to sawdust. However, there was no yield increase when perlite was used as an alternative substrate. Since perlite has lower water retention capacity compared to sawdust and especially coconut fiber, it seems that more frequent irrigation rates may be necessary to produce comparable results with organic substrates when perlite is used as a greenhouse substrate.

The significant increase in first-year data of cucumber yield with coconut fiber indicates a strong potential for the industry to increase the crop productivity by using coconut fiber. However, the second year is important to confirm these results.

The significant increase in first-year data of cucumber yield with coconut fiber indicates a strong potential for the industry to increase the crop productivity by using coconut fiber.

Experiments with zeolite

The setup and general methodology of experiments was the same as described above. Different zeolite concentrations (10, 20 and 40%) were added to sawdust, perlite and coconut fiber (V/V).

There were significant increases in produce yield and worth when zeolite was used as substrate amendment for bell peppers. The difference was especially pronounced for the first experiment for all three varieties including Triple4 (38%), Bossanova (33%) and Sympathy (31%) for treatment with sawdust (control) and sawdust + 10% zeolite. There was no strong correlation between zeolite content and yield increase. Therefore, 10% zeolite amendment was used in the second experiment.

The highest yield in the second experiment with bell peppers was produced in the treatment with coconut fiber + 10% zeolite (25.2 kg/m2). In the second experiment the treatments with 10% zeolite amendment to coconut fiber was the best for Sardana (from 13.0 to 14.9 kg/m2 for coconut fiber and coconut fiber + zeolite respectively) and for Sympathy (from 17.3 to 25.2 kg/m2 for coconut fiber and coconut fiber + zeolite respectively). On the other hand, there was not the same pronounced effect observed with sawdust as during the first experiment. The same trend was shown in experiments with long English cucumbers. The highest yield was produced when 20% zeolite to sawdust was used. The yield of cucumbers, cv. Flamingo, increased 24% (from 48.40 to 63.43 kg/m2).

The zeolite project showed a strong potential for zeolite applications in horticulture.

The project showed a strong potential for zeolite applications in horticulture. The positive effect could be explained through a high CEC of zeolite, which works as a natural mineral absorbent. The mechanism of zeolite action may include retaining of nutrients during the day feeding period and the gradual release during night periods when no nutrients are provided to the plants.

Effect of substrate on plant recovery from acidity stress.

Hydroponic technology provides the highest level of crop production in agriculture. However, greenhouse operations have a higher risks due to the specifics of the technology. Malfunctioning greenhouse equipment often leads to stress and even plant death. Therefore, risk management is an important part of commercial protocol. Tomato plants were grown in a greenhouse with a commercial setup for 11 months before they were subjected to solution with pH 2.5 for approximately 8 hours. After 8 hours the highly concentrated acidic solution was replaced with the regular feeding formula. The result were detrimental for most treatments. However, there was a remarkable recovery of plants grown on coir dust and substrates containing zeolites. On day two after the event, 80% of the plants on coir dust had recovered.

When 10% zeolites were part of the media, the recovery was 100%. The addition of zeolites to sawdust improved plant recovery from 5% to 40% the day following the stress event. All plants growing on substrates other than coir dust and with added zeolites eventually died. Thus, this event provided valuable information about the risk management of greenhouse crops in commercial greenhouses.

Improved management of root and stem rot diseases in greenhouse cucumber

This project is conducted in collaboration with the plant pathology program at CDCS. Please visit that section of this report for more information.

Evaluation and development of aquaponics production and market capabilities in Alberta.

An aquaponic system was built, based on the University of Virgin Islands design, as a prototype for commercialization in Alberta in 2002. It consists of four fish rearing tanks (5 m^{-3} each) and four raft hydroponic troughs (29 m^{-2} each). To test commercial feasibility of aquaponics under the climatic conditions of Alberta the food fish tilapia was selected in combination with several conventional greenhouse plants (cucumber, tomato, etc.), herbs, medicinal plants, and nutraceutical plants.

A protocol was developed for producing aquaponic crops in Alberta. More than 60 different crops and varieties were tested in a greenhouse. Based on this preliminary evaluation, 24 crops (five greenhouse vegetables and 19 herbs) were grown in trials to determine production levels.

The yield of tomatoes and mini-cucumbers reached 20.7 kg $plant^{-1}$ $year^{-1}$ and 33.4 kg $plant^{-1}$ $year^{1}$ and exceeded average values of commercial greenhouses in Alberta that employ conventional hydroponic technology. During the 2-year study, the yield of Genovese basil increased from 13 kg m^{-2} $year^{1}$ to 42 kg m^{-2} $year^{1}$ as production and harvesting methods were refined.

The yield of tomatoes and mini-cucumbers reached 20.7 kg $plant^{-1}$ $year^{-1}$ and 33.4 kg $plant^{-1}$ $year^{-1}$ and exceeded average values of commercial greenhouses in Alberta that employ conventional hydroponic technology.

This study demonstrated the technical feasibility of the aquaponic technology in Alberta. Evaluation of the economic feasibility is under way.

Efficacy of precision placement carbon dioxide supplementation in greenhouse sweet pepper production

Most greenhouse vegetable growers in South Alberta use CO_2 burners to improve yields and increase fruit size. Liquid CO_2 is considered as a safer source of carbon than CO_2 burners, which increase risk of crop damage by flue gases. Five years of experiments with liquid CO_2 in commercial setup greenhouses indicated a high potential for the precision CO_2 delivery technology. However, the prohibitive cost of liquid carbon dioxide prevented growers in Alberta to switch from CO_2 burners to safer liquid form

The objective of this project is to evaluate effect of liquid CO_2 by comparing production of sweet bell peppers in greenhouses with moderately low level of CO_2 and without liquid CO_2 supply using precision delivery system.

The level of CO_2 was decreased from 500-800 ppm in 2002/2003 to 400-500 ppm in 2003/2004. The first number indicates CO_2 level in summer. The second number indicates CO_2 level in winter. Red and yellow peppers produced higher yield on elevated CO_2 compared to ambient CO_2.

The total price of red, yellow and orane peppers were higher on elevated CO_2 compared to ambient CO_2. Thus, the plants produce more compared to ambient CO_2 despite of the indicated decrease in level of liquid CO_2. decreasing the consumption expensive commodity compared to recommended dosage 500 ppm 800 ppm.

Among three substrates, rockwool-grown plants showed the best response to increased CO_2. The highest yield increase was achieved in treatments with zeolites. The highest yield in this treatment indicates synergistic effect between zeolites and elevated CO_2. Orange peppers did not show yield improvement, but there was an increase total worth of the product due to larger size of the fruits from 55.9 and 58.8 to 66.5 and 75.7 for rockwool and coconut coir grown plants respectively.

Application of CO_2 for sweet pepper production in moderate concentrations in greenhouse operations in Alberta can be a viable alternative for providing better cost/return ratio.

Cultivation and assessment of rosemary as a greenhouse crop in Alberta.

A new technology for greenhouse production of rosemary based on hydroponics has been developed. The fertilizers were delivered with irrigation using computerized Argus Control System. The plants were grown for 8 months in troughs filled with coconut fiber mixed with 20% zeolite. The troughs were divided into sections with 7 plants in each section. The moisture content in the substrate was maintained at 75% field capacity. Biomass production was determined in the end of the eight-month growth period. The treatments were arranged in a Complete Randomized Design with 7 replicates. The plants were grown in a glasshouse under 400-500 µ mol s-1 m-2 light intensities provided through both natural and artificial lights.

Application of CO_2 for sweet pepper production in moderate concentrations in greenhouse operations in Alberta can be a viable alternative for providing better cost/return ratio.

Screening 10 varieties of rosemary for the best productivity.

The purpose of this experiment was to screen ten accessions to select the most promising varieties for greenhouse production. There is a considerable variance in rosemary plants dimensions among varieties.

Santa Barbara, Blue Boy and Severn Seas tended to form low and wide canopy, while ARP and Barbecue produced tall erect stems. The remainer of the accessions represented a transition form of canopy between these two extremes. The shape of the rosemary bush is important for mechanical harvest of the field crop.

Rex and Majorca produced the highest yield per plant and the lowest yield was observed for Blue Boy. Although, there was no significant difference between Rex and Majorca in total plant biomass, Rex accumulated considerably higher leaf biomass. Since leaves accumulate higher TPA than stems, it was important to compare relative leaf biomass production among the tested accessions. Other varieties showed significant difference in leaf/stem ratio. The most favorable ratio was shown for Blue Boy (leaf/stem ratio = 3.4). Majorca and ARP invested more assimilates to stem development. TPA concentration in leaf tissue showed considerable variation among accessions. Some of the lines were able to accumulate up to 6.69% (Blue Boy), which is considerably higher than in imported material (2-2.5% TPA). However, the crucial factor was dry leaf biomass per plant and TPA concentration in leaf tissue determining total TPA production per plant and a commercial value of a variety. The best variety accumulating highest yield of TPA per plant was Rex.

These results confirmed previous observations in field conditions made by special crops program at CDCS. Rex was selected as a most promising line for further experiments. Six hundred cuttings were taken in the beginning of February, 2004 for experiments with nutritional factors and salinity stress.

Impact of Nitrogen form and rate on productivity and medicinal properties in rosemary

Although, rosemary has been grown as a culinary herb, there was no comprehensive study conducted on nutrient preferences of this crop. Nitrogen is essential for increasing growth rate in all agricultural crops.

However, there have been controversial reports about benefits of nitrogen application for rosemary. It is known that the presence of both ammonium nitrogen and nitrate nitrogen in the nutrient solution is beneficial especially for slow growing species such as rosemary. Thus, balanced mineral nutrition seems to be most advantageous for yield of total active phenols (TPA) in rosemary production. The purpose of this study is to increase the rate of rosemary biomass production without decreasing medicinal quality. Four levels of nitrogen including 100, 200, 300, and 400 ppm were used. There was no any significant effect of nitrogen either on yield or on TPA content observed (see tables 1 and 2).

Table 1. Effect of nitrogen on biomass of rosemary grown hydroponically.

PPM	PARAMETER	BIOMASS	SE	PPM	PARAMETER	BIOMASS	SE
100	Fresh Wt	1.08	0.10	300	Fresh Wt	0.97	0.08
100	Dry Wt	0.25	0.02	300	Dry Wt	0.22	0.02
100	Stem Wt	0.069	0.006	300	Stem Wt	0.059	0.004
100	Leaves Wt	0.179	0.014	300	Leaves Wt	0.162	0.014
200	Fresh Wt	1.08	0.05	400	Fresh Wt	1.04	0.07
200	Dry Wt	0.24	0.01	400	Dry Wt	0.24	0.02
200	Stem Wt	0.061	0.003	400	Stem Wt	0.061	0.004
200	Leaves Wt	0.179	0.008	400	Leaves Wt	0.178	0.012

Table 2.
Effect of nitrogen on TPA in rosemary grown hydroponically.

PPM	TPA	se
100	3.84	0.07
200	3.90	0.06
300	3.98	0.06
400	3.76	0.09

INITIATIVES

Greenhouse Crops and provincial Aquaculture Programs proffered Alberta Aquaponics Group (AAG). A group of enthusiasts founded AAG during its first meeting in Brooks in December 2002. Annual meetings have occurred since then.

The AAG mandate is to promote development of aquaponics in the Alberta. The stakeholders include greenhouse growers, fish farmers, organic producers, retailing business, chefs associations, and consumers. AAG's goal is to coordinate activity of different groups to promote innovative technology and business in aquaponics.

TECHNOLOGY TRANSFER

The program leader N. Savidov, provided reports and technology transfer services to the industry personnel. Transferring crop production expertise regarding new crops and improved production techniques and technology, such as introduction of coir dust as a alternative substrate and aquaponics into greenhouse practice in Alberta is a strong component of this service.

The program leader also provided information to other department branches and departmental Key Initiatives and Base Hits committees.

The greenhouse crops program also offers a grower training program. This provides hands-on crop management and production training to individuals interested in becoming commercial growers. This program has produced growers who have gone on to become established owner/operators of successful commercial greenhouse businesses.

The program personnel gave presentations and participated in more than 10 workshops and conferences in 2004.

The program leader, Nick Savidov, provides information and expertise to other AAFRD staff, allied industry, financial institutions, and community planners and to grower organizations.

NURSERY CROPS

CHRISTINE MURRAY

NIGEL SEYMOUR

LEONA MEGLI

The nursery crops program is focused on research into cultural management practices for commercial nursery production of both field and container-grown plants and the evaluation of new plant species and cultivars. Technology transfer activities include seminar presentations, magazine articles and research reports directed to growers and other members of the nursery-landscape trades industry as well as potential growers. A close association with Landscape Alberta Nursery Trades Association (LANTA) allows for excellent communication with the commercial industry.

The program leader also provides information services to other AAFRD staff and to producer and commodity organizations. Details of research trials are presented in *Nursery Crops Program 2003*, CDCS Pamphlet 2004-8.

WOODY PLANT EVALUATION TRIALS

Regional woody plant test program

Since 1983, AAFRD staff, the LANTA Growers Group and Research Committees has cooperated to develop and maintain The Regional Woody Plant Test Program (RWPTP). New tree and shrub introductions, generally from North America, are evaluated for five years at six different sites representing different climatic regions in the province. Growth and landscape quality data are collected each year. Eleven new selections were planted at each site in the spring of 2004. Evaluation of twelve new selections planted in 1999 was completed this year. A standout selection was *Physocarpus opulifolius* 'Snowfall', an excellent hardy drought resistant shrub with large white flower clusters appearing in mid summer.

A standout selection was *Physocarpus opulifolius 'Snowfall', an excellent hardy drought resistant shrub with large white flower clusters appearing in mid-summer.*

For more information about the RWPTP from 1983-2000 see *Regional Woody Plant Test Project 2004, CDCS Pamphlet #2004-3* or on the internet at <http://www.agric.gov.ab.ca/crops/trees/rwptp/index.html>.

Prairie regional trials

The Prairie Regional Trials (PRT) were established in 1958 to evaluate the hardiness of woody plants on the Canadian Prairies and continue today in cooperation with AAFC- Morden in Manitoba. The plants in the PRT are evaluated for five years at seven prairie sites including CDCS. The growth and landscape quality data collected each year are sent to Morden where a report is produced approximately every three years and is now available at the internet website <http://res2.agr.ca/winnipeg/prt59_58.html>. In 2004, there were no additions to the trial. In 1999, nine *Rosa sp.*, *Picea englemanni*, *Aesculus hippocastanum* and one numbered *Cornus sp.* were planted and the evaluation was completed in the fall of 2004. All the roses tried did very well including 'Prairie Joy' and 'Morden Snowbeauty', which were exceptional. The *Picea* which was very slow growing and the *Aesculus*, which died back every year, were not recommended. The numbered *Cornus* proved to be a hardy yellow stemmed variety prone to aphid infestations in the fall.

Alberta Perennial Garden Trial

In response to the huge growth in interest and sales of herbaceous perennials, the Calgary Zoo and Botanic Garden, LANTA Retail Operators Commodity Group and CDCS cooperated to develop the perennial demonstration and evaluation garden from 1999-2001at the Calgary Zoo in the Dorothy Harvie Gardens. A second phase of the trial began in the spring of 2002 with addition of demonstration gardens at the Olds College Botanical Gardens in Olds and at the Muttart Conservatory in Edmonton, Alberta.

The project objectives are:

- to evaluate new species and cultivars of perennials for hardiness and landscape quality under Alberta conditions;
- to compile and publish the results for the public, retailers, growers and landscape professionals;
- to increase the knowledge about new perennials.

This project was complete in the fall of 2004, a technical document *Alberta Perennial Trials 2002 –2004* has been published and is available from the LANTA Retail Operators Commodity Group. A public document to be available at retail outlets will be published for the spring of 2005.

The evaluation of six systems of holding harvested trees during the shipping season.

Caliper trees are harvested in a short period that begins with spring thaw and ends when the trees leaf out. There is a need for trees in the landscape industry from spring thaw to winter freeze up; thus, thousands of trees are held by growers across Alberta during the growing season.

Maintaining the quality of the trees during this period is important for trees to retain their value, continue to grow and transplant successfully. When trees are harvested, then balled and burlapped, as little as 5% of the root system is retained within the rootball. The remaining small root system must provide sufficient water and nutrients for the top to continue to grow and to grow replacement roots for those lost at harvest while the tree is being held before transplanting to its final location.

It is also important that the trees do not root out into the soil surrounding the rootball during this period. These newly developed roots are generally broken and destroyed by moving and shipping resulting in a second transplant shock for the tree.

Brandon Elm trees were harvested with a tree-spade, wrapped in burlap and placed in wire baskets and transported to CDC South, Brooks early June 2002. They were placed in a holding area in one of six systems; 1) placed back into hole of the same size (control), 2) placed into hole of same size with dual layer plastic bag around rootball 3) placed back into hole with 1/3 of basket above ground 4) placed on surface of soil with dual layer plastic bag around rootball 5) placed on geotextile on soil surface and completely mulched with wood product 6) placed into hole of same size lined with geotextile. The trees were irrigated throughout the season.

Top-growth was measured in the fall of 2002. For half the trees in the fall of 2002 and the remaining in the spring of 2003, roots were harvested inside the original rootball as well as roots growing outside of the rootball into the surrounding soil or mulch. No differences in top growth or roots inside the rootball were found among treatments. The roots growing outside of the rootball were significantly greater for the mulched treatment (5) than the remaining treatments, followed by the 1/3 above ground treatment (3) and the control(1). Roots growing outside the rootball are likely to be damaged when the tree is moved to the landscape which may result in poor transplant success.

This trial was repeated in 2003 to measure the impact the holding system had on transplant success. Harvested Brandon Elms were placed in the holding area in identical treatments and the growth was measured on the trees. The trees were planted in the landscape in May 2004 by the Town of Brooks and growth measurements and observations was be taken during the growing season of 2004. A final evaluation will occur in the spring of 2005.

Zeolite as a media component for containerized shrubs.

Zeolites are microporous crystalline solids with well-defined structures. Generally they contain silicon, aluminium and oxygen in their framework and cations, water and/or other molecules within their pores. Many occur naturally as minerals, and are extensively mined in many parts of the world. Others are synthetic, and are made commercially for specific uses, or produced by research scientists trying to understand more about their chemistry. Zeolites reduce nutrient loss due to leaching by increasing the retention of the nutrients and slowly releasing them as needed by plants.

Rooted *Potentilla fruticosa* 'Coronation Triumph' cuttings were potted into #2 pots in May 2004. Treatments consisted of four levels of zeolite in the media, 0%, 20%, 40% and 60% at three rates of Nitrogen; low N at 4g/pot, medium N at 6g /pot and high N at 8g /pot. Phosphorous and potassium were applied at the rate of 6g / pot for all treatments and micronutrients at recommended rates.

The growth index of the plants was measured in September 2004 and the top growth was harvested and dried. The dry weight and growth index (height*width/2) showed no differences amoung the zeolite treatments but growth index and dry weight was significantly higher at the high N rate (8g N/pot) compared to the low N rate treatments (4gN/pot).

The impact of potassium on winter hardiness of six species of container grown shrubs

To understand the impact that potassium (K) fertility may have on winter hardiness of container grown shrubs, six species were potted into #2 pots in May 2004, and fertilized with three rates of potassium; low K at 4g/pot, medium at 6g/pot and high at 8g/pot. Nitrogen and phosphorous were applied at 6g/pot for all treatments and micronutrients at recommended rates. The species were: *Cornus alba* 'Bud's Yellow', *Philadelphus virginalis*, *Physocarpus opulifolius* 'Diabolo', *Potentilla fruticosa* 'Pink Whisper', *Rosa* 'Thérèse Bugnet', *Syringa meyeri*. These were species which growers have experience winter damage as container grown plants

In September 2004, growth index were measured and the pots were put into three different overwintering scenarios;
•optimum - white plastic covered hoop house and plants covered with thermal blanket cover
• moderate - consolidate pots, surround with hay bales
•low - consolidate pots no other protection.

The temperature in the pot will be monitored through the winter 2004/05. In the spring the winter damage under each treatment will be assessed.

Recycled greenhouse substrate

Alberta's greenhouse industry grows more than half the crops hydroponically using bags filled with sawdust, coco peat or other materials. Typically, when the crop is finished, the media has been degraded and will be discarded. This used material may contain nutrients that could be used and be a useful media component for container grown nursery stock.

In May 2004, rooted *Ribes alpinum* cuttings were potted using #2 pots into media containing used greenhouse substrates as components. Media were composed of 25, 50 and 100% used greenhouse substrate: 1)coconut fibre, 2) coconut fibre + 10% zeolite, 3) sawdust, 4)sawdust + 10% zeolite (10%) And the remaining volume consisted of 90% peat and 10% sand. For a control treatment, a standard mix of 45% bark, 45% peat and 10% sand was used. There were two rates of Nitrogen applied; low 4g N/pot and high 8g N/pot. Phosphorous and Potassium were added to the media at the rate of 6g / pot for all treatments and micronutrients at recommended rates.

The growth index of the plants was measured in September 2004 and the top growth was harvested and dried. The high nitrogen level was significantly greater than the low rate for dry weight and growth index (height*width/2) in all the media treatments. The plants grown in coconut fibre at 100%, 50% and 25% and coconut fibre plus 10% zeolite had significantly greater dry weights than the other treatments. For all treatments both dry weight and growth index were significantly greater than the control.

This project is a part of Dr. Nick Savidov's greenhouse project: *Evaluation of greenhouse substrates containing zeolite and secondary use of spent substrate* discussed in the greenhouse programs report.

Plant collections

Plant collections have been developed and maintained at CDCS as a living reference collection for use by horticultural professionals and the general public.

The **Golden Prairie Arboretum** was established in 1981 at CDCS. The collection now contains 312 species of 68 genera for a total of 531 deciduous trees and shrubs. These plants represent most of the deciduous woody plant species that can be grown on the prairies. A complete listing of the collection is available in *Golden Prairie Arboretum, ASCHRC Pamphlet 93-1.*

The **Forever Green Pinetum** collection of coniferous trees and shrubs at CDCS was established in 1986. At present it contains 26 species of nine genera for a total of 120 trees and shrubs. A complete listing of the collection is available in *Forever Green Pinetum, ASCHRC Pamphlet 93-12.*

The **Rose Garden** contains 241 specimens, many of which are unique to the CDCS collection. Many early Canadian rose cultivars and notable crosses of Canadian rose breeders, Skinner, Bugnet and Wallace are maintained in the collection. The Communities in Bloom Committee in Brooks have taken over the maintenance of the maintenance of the rose garden on a volunteer basis under the direction of the Nursery Crops Technologist. Routine maintenance was carried out in the other areas.

Technology Transfer

Technology transfer to the growers is accomplished through work with the LANTA Growers Group, Western Nursery Growers Group, and by the production and distribution of the Nursery Crops Trial Report and other published material, updating a website database and the presentation of seminars including research update at the Alberta Horticultural Congress.

PEST RISK MANAGEMENT

Field schools

In 2004 the Pest Risk Management Specialist provided entomological support to the planning and instruction at the Provincial Diagnostic Field School at Ellerslie and the Southern Alberta Diagnostic Field School at Lethbridge. Both field schools were highly successful. In southern Alberta the target crops were winter cereals, peas and mustards. The Edmonton field school was much larger with many components across a wide number of crops which trained over 1500 industry representatives, producers and department staff.

The Provincial Diagnostic Field School in Edmonton attracts 1500 industry representatives, producers and AAFRD staff

Demonstrations and research

The Pest Risk Management Specialist provided planning and field support for field trials by CDCS research staff, AAFC staff and U of A staff. These trials included work on insects in dry beans, wheat stem sawfly, wireworm and cabbage seed-pod weevil.

Two research projects were planned and carried out: Management of Seed Corn Maggot in Dry Beans and Investigation of a New Pest in Timothy. The dry bean project was funded through industry cooperation while the timothy project had minor industry funding and significant in kind contribution.

Planning support was also provided for demonstrations, field trials and activities of the Southern Applied Research Association and the Chinook Applied Research Association.

Extension support

Presentations were prepared and given in response to requests for information or skill development related to insect concerns in crops. More than 1100 participants attended these meetings. These meeting included the Southern Alberta Conservation Association Conference at Medicine Hat and the Agronomy Update in Lethbridge. The Pest Risk Management Specialist also was a member of the planning committee for the Agronomy Update.

Agronomic support and training was also provided to industry clients through one on one consultation and electronic delivery. This was provided in concert with provincial Ag-Info Center staff on entomology issues throughout Alberta.

Pest monitoring

Worked extensively with partners to develop a pest monitoring network in the province of Alberta and join this through cooperative efforts to a Western Canadian system. Twelve pest species (both insects and crop diseases) were monitored in 2004 and forecast maps (for 2005) were created for six of these pests.

The development of a dynamic pest risk predictions system is well under way in cooperation with PFRA and the other prairie provinces. Once complete the first version of the program will update risk maps for two pest species (bertha armyworm and diamond back moth) on a daily basis as new monitoring information becomes available. Other insects species will be added once the system is stable and working well.

Masters Degree in Entomology

Completed outstanding research requirements and completed first draft. Tentative defense date April 12, 2005.

PLANT PATHOLOGY

RON HOWARD,
SHARON LISOWSKI
DUSTIN BURKE
DAVID SLOMP
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The plant pathology program conducts applied research on economically important diseases of horticultural, special and forage crops. These studies involve field, laboratory, growth chamber, controlled environment storage and greenhouse experiments, as well as disease surveys.

Although most of the program's activities are carried out in southern Alberta, a few trials and surveys are also conducted in central and northern Alberta. Projects are supported by funding from external sources such as the Agriculture Funding Consortium, commodity organizations, grower associations, and seed, pesticide and equipment companies. Program staff collaborate with colleagues at CDCS and other research institutions in carrying out research, disease survey and technology transfer activities. Visit the publications and presentation section of this report for further information.

Some of the key external cooperators in 2004 were:

Fruit Crops	K. Fry, ARC
Greenhouse	M. Mirza, CDCN; P. Bains, Agri-Research Ltd., Edmonton; P. Kharbanda and J. Yang, ARC
Nursery Crops	R. Spencer, AAFRD, Stettler
Potatoes	P. Bains, Agri-Research Ltd.,; P. McAllister, CDCN, Edmonton; A. Parra, PGA, Taber; K. Basu, BioVision Seed Labs, Edmonton
Pulse Crops	K.F. Chang and H.U. Ahmed, AAFRD, Lacombe; S.F. Hwang, ARC
Vegetable Crops	S. Strelkov and S.M. Xue, U of A, Edmonton; P. Laflamme, AAFRD, Grande Prairie; K. Topinka and J. DeMulder, CDCN R. Spencer, AAFRD, Stettler

DISEASES OF FRUIT CROPS

Incidence and severity of white pine blister rust and powdery mildew in currant and gooseberry orchards in southern Alberta.

A survey of currant (*Ribes nigrum* and *R. rubrum*) and gooseberry (*R. grossularia*) orchards in central and southern Alberta in 2002 and 2003 showed that powdery mildew (*Sphaerotheca mors-uvae*) and white pine blister rust (*Cronartium ribicola*) were the most widespread and damaging diseases. A third season of survey work was carried out in 2004 in which eight currant and gooseberry plantings, six commercial and two research orchards, were surveyed for powdery mildew and rust in September-October. All of the black currant orchards showed symptoms of rust and, on average, 63% of the bushes were infected. The two most commonly grown cultivars, Ben Alder and Ben Lomond, were highly susceptible to this disease, while Ben Sarek and Titania were resistant. Two research plantings were also surveyed. One with cvs. Ben Alder and Ben Lomond had 100% infection, while the other with various cultivars had 18% infection. One commercial orchard had a 100% incidence of powdery mildew, while one of the research plantings had a 10% incidence.

All of the black currant orchards showed symptoms of white pine rust and on average, 63 per cent of the bushes were infected.

Red and white currants and gooseberries showed no evidence of rust or powdery mildew infection, with the exception of the white currant cultivar Blanka, which had rust. Other minor problems noted during the survey were insect damage on white currant and gooseberry at one location and on red currant at two locations, and dieback on red currant and black currant at one location each.

Efficacy of foliar fungicides against powdery mildew and white pine blister rust on black currant

One commercial orchard was selected for powdery mildew (Ben Alder) and one for white pine blister rust (Ben Lomond) fungicide screening trials. The mildew trial consisted of five treatments (Nova, Lime Sulphur, Microscopic

Sulphur, Copper 53W and Cabrio) and an untreated check, while the rust trial consisted of three treatments (Nova, Cabrio and Copper 53W) and an untreated check. Leaf samples were taken and rated visually for powdery mildew, while the ASSESS Image Analysis Software for Plant Disease Quantification was used to rate rust severity. For mildew control, Nova was the most effective, followed by Lime Sulphur. Microscopic Sulphur, Copper 53W and Cabrio were not effective. For rust, Cabrio was the most effective, followed by Nova. Copper 53W was not very effective against rust.

DISEASES OF GREENHOUSE CROPS

Improved management of root and stem rot diseases in greenhouse cucumber

In 2003, a SeAir Nutrient Oxygen Diffusion (NOD) machine was installed in a CDCS greenhouse. This machine produces microbubbles of oxygen, which diffuse into the nutrient solution and enhance dissolved oxygen levels.

In an initial trial at CDCS in 2003, cucumber plants fed with oxygenated nutrient solution showed improved growth and fruit yields with decreased levels of pythium root and stem rot.

PepMV was confirmed in only one greenhouse in the Redcliff area in 2004

Two additional trials with the NOD machine were completed in May and August 2004. For both trials, a cucumber crop was planted with half of the house on sawdust and half on cocopeat bags. Four treatments, including Pythium-inoculated/non-inoculated and oxygenated/non-oxygenated nutrient solutions, were evaluated for their effects on plant health and yield. In the spring trial, decreased plant mortality and lower levels of disease in sawdust bags fed with oxygenated water were noticed in comparison to the inoculated treatment without oxygen. In the summer trial, the mean total yields for the oxygen treatment were substantially higher than the untreated control and a very low level of disease was found in plants on sawdust bags receiving oxygenated solution.

At the end of August 2004, an electrochemically activated (ECA) water machine was installed in a CDCS greenhouse. This machine generates disinfectant ions from a potassium chloride brine solution that passes through its electrodes. This trial commenced in September and continued until the end of November, but a few problems occurred with the nutrient delivery system in the greenhouse. This problem will be remedied in trials planned for 2005.

Survey for diseases on peppers

CDCS staff surveyed eight pepper greenhouses in southern Alberta for fusarium stem and fruit rot, Pepper Mild Mottle Virus and other diseases. Internal fruit rot, caused by *Fusarium* spp., was the most prevalent problem. Stem rot, blossom-end rot, edema and nutrient deficiencies were also seen.

Survey for Pepino Mosaic Virus in tomatoes

In March 2004, eight greenhouses in southern Alberta were surveyed for Pepino Mosaic Virus (PepMV), a highly infectious viral disease of tomato,. A similar survey in 2003 showed that the disease was present in two Redcliff area commercial greenhouses. PepMV was confirmed in only one greenhouse in this area in 2004. The incidence and severity were low and the economic impact was minimal. Symptoms disappeared once the warm spring weather arrived. There were no other reports of PepMV on tomato crops in Alberta in 2004.

DISEASES OF NURSERY CROPS

Black knot survey

A field survey was conducted in 2003 to assess the geographical distribution and economic importance of black knot, a fungal disease caused by *Apiosporina marbosa*, in wild and cultivated plantings of *Prunus* species (plum family) in Alberta. Surveyors visited a variety of habitats, including orchards, amenity plantings, parks, boulevards, research collections, nurseries, natural areas, arboreta and shelterbelts in 27 locations. A follow-up survey was conducted in 2004 at four widespread locations. A disease index was calculated for each site to quantify the incidence and severity of infection. The main Prunus species examined were *P. maackii* (amur cherry), *P. virginiana* (chokecherry), *P. padus* (mayday) and *P. pensylvanica* (pincherry). In Brooks, all Prunus species on town property were surveyed and disease incidence and severity were relatively low. For Grand Prairie, Lacombe and the Rural Municipality of Wood Buffalo, surveys were restricted to areas of high incidence and severity. In some cases, hundreds of galls were observed on individual trees.

Assessing techniques for managing black knot on Prunus species in Alberta

Cooperators from the 2003 black knot survey were contacted and asked to provide information on the techniques they used to manage black knot in *Prunus* spp. in their respective operations. The management techniques were categorized as low, medium and high intensity, depending on the complexity, time and money required to carry them out. In general, nurseries followed high intensity practices, which was reflected by the low levels of disease incidence and severity at these locations. Most cities and towns followed medium intensity management practices, while low intensity practices were seen in many backyards and in areas where native chokecherries grew.

DISEASES OF POTATOES

Evaluating methods for the control of seed-piece decay, wilt and dry rot caused by Fusarium species

This project was started in spring 2004 and included a seed potato survey, a field survey for wilt diseases and seed treatment efficacy trials. In the seed survey, 20 samples of seed potatoes were submitted to CDCS, along with information on the production history for each lot. During the summer, a wilt survey was done in 17 fields of processing potatoes in southern Alberta.

The purpose of both surveys was to measure levels of *Fusarium* contamination in the seed and stems, and also to identify the main *Fusarium* species responsible for seed-piece decay, wilt and dry rot. The seed survey showed widespread differences in disease levels between farms, ranging from no detectable disease to up to 100% seed infestation with *Fusarium* spp. The field survey indicated that *Verticillium* caused substantially more wilt than *Fusarium* did this year. In addition, *Colletotrichum* was also commonly isolated from infected plants and may be an important component of the early dying complex in potatoes. *Fusarium sambucinum* was the most common dry rot pathogen seen in infected tubers. The identification of *Fusarium* isolates and an assessment of their sensitivity to fungicides in vitro will be carried out in 2005.

Two identical seed-piece treatment fungicide trials were initiated at CDCS and in a plot near Edmonton in cooperation with Dr. Piara Bains, Agri-Research Ltd., Edmonton. These trials compared the effectiveness of various fungicides against seed-piece decay fungi. Potatoes were artificially inoculated with *Fusarium*, and later coated with the respective seed piece treatments prior to planting. Data collected in 2004 included emergence counts and tuber yields. Several of the fungicides, including Maxim MZ and Genesis XT, appeared to reduce seed piece decay.

Resistance of potato breeding lines to early blight under field conditions

Twenty-five advanced breeding lines and two standard cultivars from the Western Canadian Potato Breeding Program based at AAFC, Lethbridge were screened for resistance to early blight (*Alternaria solani*) in a naturally infected trial at CDCS in 2004. Three visual estimates of incidence and severity for both the field canopy and compound leaf samples were taken at the end of August and during the first three weeks of September, when disease levels were highest. Disease presence was very high in many of the cultivars by the end of the growing season. Data were summarized and statistical analysis is in progress.

Tubers stored very well over the 10 month trial period. Washed tubers had a higher disease rating than unwashed.

Long-term storage of creamer-sized gourmet potatoes

Creamer-sized gourmet potatoes, sized 19-41 mm, are marketed to high-end restaurants and retail outlets as a premium specialty item. Growers and packers must be able to supply a high quality product year round. Little research has been performed with the long-term storage of this product.

This two-year study, began in 2003 and was funded by the Little Potato Company, Edmonton, had two objectives: to determine the effects of long-term storage of these potatoes, and to find ideal conditions so that the length of storage can be prolonged.

Three varieties of small potatoes, Bintje, Nordonna and Blue, were received as washed and unwashed samples in November, 2003 and were placed into long-term storage in a controlled environmental storage room at 5°C and 93% RH. Evaluations commenced in November, 2003 for all three varieties and included assessments for infectious and non-infectious diseases. The evaluations continued at bimonthly intervals for infectious diseases only, until the final evaluation in September, which again included non-infectious diseases.

In general, the tubers stored very well over the course of the ten-month study under the conditions of this trial. The washed tubers had higher disease ratings than the unwashed tubers and were also more prone to dehydration.

A survey to assess the distribution, incidence and severity of Alternaria species causing leaf blight on potatoes in southern Alberta

The objectives of this survey were to: assess the distribution, incidence and severity of *Alternaria* species causing brown spot and early blight in commercial potato fields; assess the frequency of disease in individual fields and finally; and measure in vitro sensitivity/resistance *Alternaria* spp. to the main foliar fungicides used in Alberta. The effectiveness of current crop management practices employed by growers to control these diseases was also assessed.

Potato Growers of Alberta staff surveyed 30 potato fields in southern Alberta and took disease ratings on the plant canopy and obtained composite leaf samples from each for detailed assessments at CDCS. Twenty-eight samples were examined and individual leaf ratings were performed. Average disease incidence and severity ratings were calculated for each field. *Alternaria* spp. were isolated from each sample by BioVision Seed Labs, Edmonton, and will be used for fungicide sensitivity testing. Tentative results showed that there were widely varying incidences and severities of leaf blight between the fields. Both species of *Alternaria* were isolated from all of the surveyed fields. Fungicide sensitivity tests will be carried out in 2005.

DISEASES OF PULSE CROPS

Field validation of common bacterial blight resistance in six cultivars of navy dry beans

CDCS was one of six locations across Canada chosen for this study; the others were Exeter and Elora, ON, Morden, MB, and Saskatoon and Outlook, SK. Small lots of healthy seed of six cultivars of navy dry beans were obtained from Ridgetown College, University of Guelph, Ridgetown, ON. Two field trials were established; one was inoculated four times in August with isolates of *Xanthomonas axonopodis* pv. *phaseoli* and *Xanthomonas axonopodis* pv. phaseoli var. *fuscans*, and one was left uninoculated. Humid conditions persisted for much of the growing season, which created ideal conditions for disease development. As a result, the inoculated trial had ca. 100% disease incidence. Unfortunately, the trials were damaged by frost before undercutting (ca. –0.5°C on Sept. 20), so performing a disease rating on the seed wasn't possible.

Statistically significant differences in emergence and seed weight were noted between cultivars for both the inoculated and non-inoculated trials. In the inoculated trial, the resistant cultivar HR67-1675 yielded significantly better than the susceptible cultivars AC Compass and Envoy, but not better than Navigator and CDC Whitecap. The other resistant cultivar under test, OAC Rex, did not differ from the four susceptible cultivars. No significant differences in disease incidence or severity were noted between any of the six cultivars.

Evaluating alternative fungicides for controlling sclerotinia white mold on dry beans in Alberta

Portions of two commercial dry bean fields in the Burdett area were sprayed with six fungicides, once at a full rate for a single application and twice at a reduced rate for a split application. Untreated check and grower's spray program plots were included for comparison, and disease incidence and yield data were collected throughout the growing season and at harvest, respectively. The level of white mold infection at the two trial sites was sufficiently high to challenge the fungicides under test. The fungicides did not give consistent results between the two sites; however, Benlate, Lance and Senator tended to outperform Botran, Calcium Carbonate and Rovral in terms of reducing disease levels and improving seed yields.

The timing of sprays in the six fungicide treatments trials was planned to coincide as closely as possible with the growers' spray programs; however, inclement weather delayed the final application in the two trials by 5-7 days relative to the rest of the field. This delay might have had an impact on the performance of the split applications, especially given that favorable environmental conditions for white mold development that occurred during the period of the delay. Single applications were slightly more effective than split applications in reducing disease and increasing seed yields when data from both trial sites were considered.

Epidemiology of bacterial blight diseases on dry beans in Alberta

Eight dry bean fields in southern Alberta, which showed evidence of bacterial blight, were surveyed for disease incidence and severity at five locations per field. Samples were taken for further leaf and pod disease incidence and severity ratings. Farm machinery, insects, rotational crops, bean seed, soil, water and weeds were also sampled for each field or farm, where possible. Isolations were carried out on all samples with selective media. PCR analysis for the presence of bacterial blight pathogens, including brown spot (*Pseudomonas syringae* pv. *syringae*), common blight (*Xanthomonas axonopodis* pv. *phaseoli*), halo blight (*P. syringae* pv. *phaseolicola*) and fuscous blight (*X. axonopodis* pv. *phaseoli* var. *fuscans*) is underway.

Determining the cause of early yellowing syndrome on dry beans in Alberta

Fact-finding, field survey and laboratory testing activities were planned to help determine the cause of EYS on dry beans; however, no cases of EYS were reported in 2004. Temperatures during the growing season were cooler than normal and rainfall levels were plentiful, especially early in the season. These conditions were not conducive to the development of EYS, which seems to be favored by heat and/or drought stress. A review of EYS outbreaks from previous years and literature reviews are continuing.

Wider row spacings and reduced seeding rates, as well as using cultivar resistance, crop rotation and fungicides, could be used to manage ascochyta blight.

Manipulation of row spacing and seeding rate for the management of ascochyta blight of chickpea

A major factor that limits the production of chickpea in western Canada is ascochyta blight (*Ascochyta rabiei*). Plant density and row spacing may have a profound effect on the epidemiology of this disease. Two chickpea cultivars, three row spacings and three seeding rates were evaluated for their effect on the incidence and severity ascochyta blight in a trial at CDCS. Disease data were compared for each treatment throughout the growing season. Significant differences in disease levels were observed between cultivars, among seeding rate treatments and among row spacings later in the season. No interactions occurred among these parameters.

Disease progress was slower in the desi cultivar Myles compared to the kabuli cultivar Dwelley. Later in the season, both disease incidence and severity increased rapidly in Myles. Higher plant populations, due to reduced row spacings and higher seeding rates, significantly increased disease levels. These preliminary results suggest that wider row spacings and reduced seeding rates, in addition to the use of cultivar resistance, crop rotation and fungicides, could be used to manage ascochyta blight of chickpea.

Survey for ascochyta blight of chickpea in southern Alberta

Ascochyta blight is a serious threat to chickpea production in Canada. Monitoring the disease situation is a prerequisite for developing effective disease management strategies. A survey was conducted to determine the occurrence of ascochyta blight of chickpea in southern Alberta in 2004. A total of 28 fields comprising 2579 acres were scouted for the disease.

Average disease incidence and disease severity were 23.4% (range 0-100%) and 0.75 (range 0-3 where 0 = no disease; 3= 100% plant disease severity), respectively. Kabuli type chickpeas were predominantly grown in this area. Growers reported that crop performance was satisfactory where they took early preemptive disease management precautions.

DISEASES OF VEGETABLE CROPS

Identification and characterization of clubroot in cole crop vegetables in Alberta

Clubroot, caused by *Plasmodiophora brassicae*, infects vegetables and oilseed crops in the Brassica family. Infrequent and isolated reports of clubroot in home and market gardens in central Alberta have been made over past 30 years. The most recent outbreak was in Chinese cabbage at a market garden near Leduc in 2001. The first confirmed case of *P. brassicae* in canola in western Canada was in a field near St. Albert, Alberta in 2003. This discovery was a serious concern to canola and vegetable growers for a number of reasons, including the widespread cultivation of these crops in regions of Alberta containing acidic soils, which may favor pathogen survival and disease development.

A project was initiated in 2004 to assess the prevalence of clubroot in cruciferous vegetables, to screen for clubroot resistance in broccoli, brussels sprouts, cabbage, cauliflower, kohlrabi, radish, rutabaga and turnip, and to test the possibility of seed transmission of *P. brassicae*. A survey of over 20 vegetable fields across Alberta in September-October, 2004 revealed no occurrences of clubroot. A comprehensive disease rating of more than 50 cole crop varieties planted in an infested field at the CDC - Edmonton showed low levels of infection (<10%). Results of vegetable seed assays are pending.

POTATO AGRONOMY RESEARCH

MICHELE KONSCHUH

SIMONE DALPÉ

Alberta's Potato Industry

The potato industry in Alberta has been expanding over the past several years. In 2004, more than 52,500 acres of potatoes were grown in Alberta, 38,000 acres for processing (fries and chips); 11,000 acres to seed potatoes and 3,500 acres as tablestock. There are three major fry processing plants in southern Alberta, two potato chip plants and a number of packers. The overall value of the industry in Alberta has been estimated at over $300 million dollars.

Potato Agronomy Research Program

The objectives of the program are to foster increased production efficiency and competitiveness of the potato industry in Alberta. The main focus is on issues affecting irrigated potato production for processing and tablestock. Seed potato issues are addressed by Tricia McAllister at CDCN. The majority of the research trials are sponsored by industry or industry organizations. In 2004, approximately 70% of the trials were conducted in small plots at CDCS, while the other 30% were done in co-operator fields near Ranier, Vauxhall, Rolling Hills, Taber, Burdett and Bow Island. It is easier to control experimental parameters in small plot trials, but yield estimates and crop quality are often more relevant in grower controlled settings.

RESEARCH PROJECTS

Timing of power hilling for russet burbank in southern Alberta

Sponsored by the PGA, trial at CDCS.

The purpose of this 2+ year project is to compare not hilling with conventional and power hilling at regular intervals after planting to determine how much damage and yield loss is sustained as a result of late hilling operations. Potatoes are graded for total yield, marketable yield, deformities, greening and internal defects. In 2003, all hilled treatments resulted in greater total yield than the control (not hilled). In 2004, however, the control (not hilled) treatment resulted in yields not significantly lower than hilled treatments. The greatest total and marketable yield was observed when potatoes were power hilled at ground crack in 2003, and at emergence in 2004. Soil temperature was monitored in hills from each treatment in 2004. Power hilled treatments provided greater insulation against environmental temperature fluctuations than disc hilling. Fry colors were very good for all treatments in 2004. If power hilling has not been completed by the time tuber initiation begins, disc hilling may result in a better combination of marketable yield and good fry color than power hilling late. Poor timing of hilling decreased the uniformity of tuber size. A third year of funding will be requested.

The greatest total and marketable yield was observed when Russet Burbank potatoes were power hilled at the time of ground crack and emergence.

Assessment of carotenoid content of yellow-fleshed potato cultivars grown in Alberta to determine potential nutritional benefits

Sponsored by AAFRD New Initiatives Fund, PGA, McCain Foods, Lamb-Weston, Maple Leaf Potatoes, Parkland Seed Potatoes, HZPC Seed Potatoes and Solanum International. Trial at CDCS.

This project involved growing twenty cultivars of yellow-fleshed potatoes in two Alberta locations and analyzing them for flesh color intensity, total carotenoid content and concentrations of lutein and zeaxanthin. Flesh color assessment and carotenoid analyses have been completed, however, data has not yet been analyzed. Promising lines will be assessed after storage and cooking or processing to determine the stability of carotenoid compounds in potato tubers. Lutein and zeaxanthin are two carotenoid compounds associated with reduced incidence of age-related macular degeneration and cataract formation. Potato cultivars with significant concentrations of lutein and zeaxanthin may be marketed in the future as functional foods.

Efficacy of Royal MH30 Xtra on table and processing potato cultivars as compared to MH60

Sponsored by Crompton. Trial at CDCS.

Royal MH60 has been marketed as a growth regulator applied in-season to potatoes to confer sprout inhibition in storage. Recently, claims that MH60 can improve grade and quality of potatoes increased interest in the product. Also, a different formulation of the growth regulator is marketed in the U.S. as Royal MH30. Royal MH60SG and Royal MH30 (maleic hydrazide) were applied to Russet Norkotah (table) and Russet Burbank (processing) potatoes at two stages of tuber development to determine if it is possible to increase the percentage of potatoes in the 6 to 10 ounce range without sacrificing yield. As well, potatoes were placed in storage to determine the effectiveness of maleic hydrazide as a sprout inhibitor. Storage data will be available in June 2005.

Effect of MH60 on sizing in chipping potatoes

Sponsored by the PGA and Frito-Lay

Application of the registered rate of MH60 increased both total and marketable yield.

Royal MH60 has been marketed as a growth regulator applied in-season to potatoes to confer sprout inhibition in storage. Claims that MH60 can improve grade and quality of chipping potatoes from storage increased local interest in the product. MH60 (maleic hydrazide) was applied to commercially grown Frito Lay (FL) potatoes at three rates to determine if it was possible to increase the percentage of marketable potatoes out of storage without sacrificing yield. Potatoes were harvested and graded at CDCS and in a commercial lab to determine the effectiveness of MH60 applications. Potatoes will be assessed again after 8 months of storage. In 2003, the timing of Royal MH60 application was critical for size control in chipping potatoes. In 2004 MH60 was applied at a full rate (100%) as well as two cut-rates (67% and 33%) two weeks before desiccation when tubers were 5 cm in diameter and compared to a check treatment. Cut rates of MH60 applied two weeks prior to desiccation did not affect the yield of FL potatoes, however, application of the registered rate of MH60 increased both total and marketable yield. Neither specific gravity nor chip scores were affected by MH60 applications, regardless of rate. The effect of MH60 on stored potato quality (sprout control and chip scores) will be determined in spring 2005.

Western Canadian Potato Breeding Program Regional Trials – Early, Maincrop and North Central Trials

In cooperation with AAFC
Trial at CDCS

As part of AAFRD's ongoing support of the Western Canadian Potato Breeding Program and the role it plays in the growth of the potato industry, early crop (80 and 95 day harvests) and maincrop regional trials and a North Central Trial for the Western Canadian Potato Breeding Program were conducted at Brooks. Eleven cultivars were evaluated against check cultivars (Atlantic, Norland, Russet Norkotah and Norvalley) approximately 80 days after planting and again approximately 95 days after planting in the early crop trial. Twenty-four cultivars were evaluated against check cultivars (Atlantic, Norland, Russet Norkotah, Ranger Russet, Russet Burbank, Sangre, Shepody and Snowden) in the maincrop trial. Data were collected on 30 to 40 agronomic and quality factors including yield, maturity, specific gravity, culinary and processing quality. Another eighteen lines were grown as part of a North Central trial comparing breeding material from Alberta with that of programs located in the north central U.S.A. Five of the cultivars evaluated against the check cultivars came out of the Western Canadian Potato Breeding Program. (CV89023-2R, FV12486-2, AC Stampede Russet, V0319-1 and V1102-1). Data for these trials are provided to the Potato Breeder with AAFC – Lethbridge.

Syngenta Federal Research Permit Sites 2004 – Maxim MZ

Sponsored by Syngenta

Although Maxim is registered as a potato seed piece treatment in Canada, mancozeb is still used by many growers to protect against tuber-borne late blight. Maxim MZ is a product containing both fludioxonil and mancozeb to provide protection against seed piece decay, *Rhizoctonia* and tuber-borne late blight. The Federal Research Permit Sites allowed large-scale comparisons between Maxim MZ and other seed piece treatments containing mancozeb. Two commercial fields of Russet Burbank potatoes in southern Alberta were included in the study. Emergence, stand count, *Rhizoctonia* stem and stolon canker, black scurf, yield, and tuber quality were assessed. Although some differences in rate of emergence were noted in each field, the final stand counts were similar regardless of seed piece treatment. The incidence of *Rhizoctonia* canker was moderate in both fields, and the severity was very low in both fields, regardless of treatment. Yield and grade of harvested tubers were very similar from Maxim MZ and the comparison treatment in both fields. Very low levels of black scurf were observed in both fields. There were no detrimental effects of using Maxim MZ as a seed piece treatment, however, the low incidence and severity of *Rhizoctonia* in both sites in 2004 made it difficult to draw conclusions about the efficacy of Maxim MZ with respect to *Rhizoctonia* control.

Awaken Product Evaluation

Sponsored by UAP Canada
Trial At CDCS

Several fertilizer products were evaluated as in-furrow at planting or foliar applications on Russet Burbank potatoes to determine the best rates and combination of products to enhance yield and potato quality. Emergence was similar between all treatments and no significant difference was observed in the number of stems per plant. Applications of Awaken in-furrow and foliar applications of 10-16-38 plus Bo and Zn improved total yield relative to the check, although statistically significant differences were only observed when these treatments were combined. In most cases, this trend was also observed with marketable yield, however, a lower rate of in-furrow Awaken at planting resulted in lower marketable yield and significantly greater yield of small potatoes than the check. As expected, the higher rate of Awaken and the higher rate of 10-16-38 plus Bo and Zn resulted in greater yields than the lower rate of each product. The foliar treatment of Awaken was applied at a higher than desired rate, so results for this treatment are not valid. In-furrow applications of Riser resulted in slight improvements in marketable yield relative to the check, but no greater total yield. No significant differences were noted between treatments with respect to specific gravity, so French fry quality is expected to be similar between treatments as well.

Wireworm identification in southern Alberta

As of spring 2004, good information on wireworm infestations or wireworm densities in fields in southern Alberta was not known. Furthermore, information about which species of click beetles are present or which species pose an economic threat to potato producers was lacking. In an effort to learn more about the prevalence of wireworm in irrigated potato fields in southern Alberta, and to determine which new pesticides may be effective for crop protection, wireworm larvae were collected from eight fields in southern Alberta that were identified as potential collection sites. Bait traps (wheat/corn/vermiculite) were placed in fields immediately after potato planting in the spring (mid April to mid May). After10 and 14 days the traps were retrieved and replaced with fresh traps.

Wireworms collected in southern Alberta were identified by Wim van Herk (AAFC - Agassiz, BC). Species identified on irrigated land in southern Alberta include *Ctenicera destructor*, *Limonius californicus* (sugarbeet wireworm), *Althos* sp., *Ctenicera morula* and *Aeolus mellillus*. These species, as well as *Agriotes criddlei* were also found in traps in dryland areas of Alberta and Saskatchewan. Although traps are a relatively simple means of determining presence of wireworm and collecting wireworm for identification, they are not a good indicator of population density. Also, the lack of wireworm in traps is not an indication of the absence of wireworm. The information gathered in southern Alberta in 2004 will aid in planning future collections and wireworm control strategies.

Evaluation of products for wireworm control on irrigated potatoes in southern Alberta

Sponsored by Gustafson and Syngenta

Several wireworm control products will be de-registered by PMRA over the next few years. Although Alberta does not currently have high wireworm populations in potato growing areas, there is concern that numbers will increase as control products become less available. A trial was situated in a commercial Russet Burbank field and involved comparing the standard wireworm control product with some potential new products. Potatoes from treated seed were to be compared to potatoes from untreated seed and assessed for wireworm damage and yield. The level of wireworm damage observed in the check treatment was insufficient to allow for efficacy of the treatments to be determined, and the trial was not harvested. Another trial will be considered for 2005.

TECHNOLOGY TRANSFER

Information was provided by the program leader, M. Konschuh, to producers, processors and other industry staff. Information about cultivar evaluations and research projects was presented at industry meetings and through direct contact.

POTATO EXTENSION

LORI DELANOY

The objectives of the potato extension program are to provide sound agronomic advice and assist the industry in improving potato quality and maximizing yield. This is done for Alberta's potato industry through direct contact, newsletters, factsheets, workshops, conferences and presentations.

On-farm demonstration – Alberta Mobile Potato Demonstration Farm (AMPDF)

The extension agronomist, in association with the Potato Growers of Alberta, organized several demonstration projects. Each of these projects was compared with a controlled check treatment.

Application of calcium for red color retention

Published research indicates that application of calcium will increase storage color retention of some red potato varieties. Storage issues made final evaluations inconclusive.

Phosphorus application

Four separate phosphorus treatments were applied to a field of Ranger Russets. Banding, broadcast, banding/broadcast and control treatments were evaluated for marketable yield and quality. With adequate soil phosphorus, current season results indicate that there were no significant differences in marketable yield and quality when comparing the control (no additional phosphorus) and the other three phosphorus treatments.

Malathion and Sevin are no longer recommended for controlling Colorado Potato Beetle.

Colorado Potato Beetle insecticide resistance survey

For the second year, Colorado potato beetles were collected from various fields across southern Alberta. The beetles from each field were tested for insecticide resistance. Malathion and Sevin are no longer recommended for controlling Colorado potato beetles.

Petiole lab comparison

Is one lab more accurate than another for testing potato petioles levels throughout the season? Potato petioles were collected from the same area in the same field for a five-week period. Each week the samples were evenly divided and sent to southern Alberta labs for testing. The numbers varied depending on the lab. Results show that changing labs mid-season may have more of a negative effect on in-season fertility decisions than choosing one lab over another.

Industry extension

The extension agronomist assisted industry with various management decisions – in-season fertility recommendations, insecticide resistance issues, insect challenges.

The extension agronomist attended potato information seminars and conferences in Alberta. Information on new and upcoming chemicals, cultural practices and much more was obtained and is available.

The extension agronomist working in concert with the Potato Growers of Alberta established research and extension priorities.

A sweet corn survey was developed that was sent to all processing and fresh market corn growers for input in the potential development of a sweet corn production manual.

Workshops, field days and grower meetings

The extension agronomist, in association with the Potato Growers of Alberta, held four breakfast meetings beginning in early spring through to end of harvest. These meetings covered a variety of topics ranging from irrigation management, IPM, early and late blight management, insect management, to any general or specific concerns. Potato growers continue to practice a preventative disease program. The potato grower field day was held in July. All of those in attendance visited the demonstration plots listed above.

The extension agronomist, in association with other southern Alberta extension agronomists and scientists, sat on several organizing committees for upcoming conferences and workshops, such as, Agronomy Update (Lethbridge – 400 attendees) and the 2005 Southern Alberta Field Diagnostic School.

SOIL & WATER AGRONOMY

SHELLEY WOODS

LEN HINGLEY

The soil and water agronomy program conducts research on water, fertilizer and sustainable soil quality requirements of special crops, horticultural crops and irrigated forages. Some research projects were done cooperatively with staff from other programs at CDCS and other divisions of AAFRD, including the Irrigation Branch, Conservation and Development (C&D) Branch and the Canada-Alberta Crop Development Initiative (CACDI). In 2004, studies conducted by the soil and water agronomy program received funding from the Potato Growers of Alberta (PGA) and Agrium.

Research Projects

Petiole nutrient (N, P and K) recommendations for Russet Burbank potatoes grown in southern Alberta

This was year one of a three-year PGA-sponsored study with the objectives of determining the optimal petiole nutrient concentrations for Russet Burbank potatoes, specific to southern Alberta; determining the relationship, if any, between potato petiole nutrient concentrations and tuber specific gravity; and comparing these relationships to those found in field-scale petiole data. Precise fertilizer application rates are critical for optimal potato production. Sufficient nutrients are necessary to maximize tuber yield, quality and uniformity, while issues of economy and environment make excess fertilizer undesirable. The analysis of potato petiole samples has been used to monitor the nutrient status of potato crops throughout the growing season. This can be a useful and timely technique for monitoring any crop deficiencies that may occur mid-season that were not identified in spring soil samples.

Many of the current recommended petiole nutrient (N, P and K) concentrations have come from research conducted in the northwest United States, where longer growing seasons and different soil conditions and climate prevail. Petiole analysis results from previous PGA-sponsored Russet Burbank studies in southern Alberta indicated that the current recommendations may be high for potassium (K) and somewhat high for phosphorus (P), especially early in the growing season. Results from these prior studies also indicated that recommended nitrate nitrogen (N) concentrations may need fine-tuning to suit southern Alberta growing conditions. This was the impetus for this study, and initial results indicate that, at the 2004 study site, the USA standard ranges are somewhat high for NO3-N and P and slightly low for K. The latter may be because the baseline levels of soil K were quite high at the 2004 field site. In addition, a July 7 hailstorm and unusually cool wet weather may have impacted the research results. In order to make reliable suggestions for southern Alberta-specific petiole nutrient concentrations, the study should be repeated for two more years to account for a range of climatic and soil conditions.

Affects of frozen soil on electromagnetic inductance

Electromagnetic inductance is a rapid and accurate means for estimating soil salinity. It can be used in conjunction with GPS to create soil salinity maps or it can be used alone to estimate soil salinity at benchmark locations. One electromagnetic inductance meter in current use is the Geonics™ EM38. The EM38 can be used to estimate soil salinity in two modes, vertical (0-1.5 m depth) and horizontal (0-0.75 m depth), which approximate the rooting depths of perennial and annual crops, respectively. The meter is affected by ions in the soil (including salts, water and metal) and by soil temperature. Caution must be used when using the meter when soil is partially or completely frozen.

It is recommended that the EM38 not be used when the surface soil (0.2-0.5 m depth) temperature is below 0°C.

An experiment to test the accuracy of the EM38 on freezing and frozen soils was conducted for one calendar year, near Brooks, Alberta (October 20, 2003-October 22,2004). Vertical and horizontal EM38 readings were monitored weekly at ten benchmark sites. There were five wide-ranging salinity values (spaced 2-6 m apart) and two water application rates (spaced 7 m apart). One water rate (Dry) received ambient precipitation, while the other rate (Wet) received precipitation plus 9 applications of 5 mm water (total=45 mm), between June 3 and October 22, 2004. At initiation of the site, laboratory analysis of soil cores was conducted for calibration of the inductance meter readings. The results from this study indicate that, as soil temperatures decrease, EM38 readings decrease, with higher values dropping to a greater degree than lower values, obscuring differences that are apparent in warmer temperatures. In late fall to early winter, the EM38 can still distinguish between values but it is essential to take core samples to calibrate EM38 data with EC values. It is recommended that the EM38 not be used when the surface soil temperature (0.2 and 0.5 m depth) is below 0°C. The initial results and summary of previous work were presented at the 2004 ASSW (Alberta Soil Science Workshop) and the final results of the one-year study on effects of soil temperature and frozen soil on EM38 readings will be presented at the 2005 ASSW.

Effects of topography and soil horizonation/layering on long-term solute transport under semiarid conditions

Understanding of solute transport through the vadose zone in semi-arid environments (e.g., Canadian Prairie) is limited. The objective of this study is to compare the relative influence of topography and soil horizonation on the spatial variability of water and solute transport after 34 years under transient, unsaturated, semi-arid conditions. In 1966, a chloride tracer (as KCl) was applied to plots (6 m x 90 m, Chernozemic soil) near Saskatoon, SK. In 2000, a total of 202 soil cores (6 m depth) were taken from a transect, across one of the plots. The soil horizonation/layering of each core were recorded. Each core was sectioned (0.1 m intervals) and samples (N>14000) were analyzed for chloride concentration, bulk density and soil water content.

Historic sampling indicates that the chloride center of mass was at a depth of approximately 1 m after 4 years. After 34 years, the chloride center of mass is at approximately 2.76 m in slight convex areas, compared to 1.70 m in level areas. There is significantly faster transport in depressional areas, which is attributed to rainfall and snowmelt re-distribution. The influences of subtle changes in surface topography and soil horizonation/layering on the average depth and spread (vertical and lateral) of the chloride tracer continues to be studied. This project is the Soil and Water Agronomy Program Leader's PhD. thesis research, which was part of the Program's succession plan. In 2004, a massive computer simulation modeling component was completed. In addition, statistical analyses were completed and writing continued.

Phospho-gypsum for ameliorating sodic soil on a field scale

In 2004, the soil and water agronomy program was approached by a group of scientists and field staff from fertilizer companies (Agrium, Agricore United and DynAgra) to collaborate with them on a project to study the ameliorating affects of phosphor-gypsum (a fertilizer product) on a sodic soil. The participation of the Soil and Water Agronomy Program included input into project design and production of salinity maps (at two depth ranges) of the site (65 ha) near Rolling Hills, Alberta. The salinity maps were completed in May 2004, using coupled EM38™ and GPS (Global Positioning Satellite) equipment, and provided to the project manager. Mapping, and corresponding soil sampling, indicated that sodicity was no longer a problem at the site.

Soil salinity tolerance of potatoes

In 2003, a one-year project was done in collaboration with staff from the Irrigation Branch. Because of difficulties with the harvest of the Russet Burbank potato crop, plans were made to repeat the study in 2004, at the location of the 2004 CACDI potato crop. Spring salinity mapping of the site was completed, using coupled EM38™ and GPS equipment. The site proved to be uniformly very low in soil salinity, disallowing the project to be conducted in 2004. It is hoped that the study can be done at some future point, when the CACDI potatoes are grown on a site with sufficiently variable soil salinity.

TECHNOLOGY TRANSFER

Soil and water information was provided to a diverse audience through papers, posters and presentations. Presentations were made at producer tours and inquiries were answered through telephone contacts, office visits and correspondence.

Information on methods of soil salinity measurement and crop tolerances to salinity were provided to various groups, including lectures at "The Right Amount Conference" in Taber (February 25, 2004); at the Vulcan CAESA Salinity Workshop (March 24, 2004); for the CDD Meeting Tours of CDCS (June 16, 2004); at the Lethbridge Diagnostic Field School (June 29-30, 2004); at the University of Lethbridge (Geography 4760: Agricultural Soil Management) (September 24, 2004); and at the Southern Alberta Conservation Association Conference (November 30, 2004). A presentation was made to a visiting Australian producer (Mr. John Young) on travel fellowship to North America (September 7, 2004). Poster and oral presentations were given at the Alberta Soil Science Workshop and at the joint Annual Meeting of the American Society of Soil Science and the Canadian Society of Soil Science. A poster presentation was also made at the Annual Meeting of the Potato Growers of Alberta.

SPECIAL CROPS

MANJULA BANDARA

FORREST SCHARF

JUDY WEBBER

DEBBIE SCHUILING

The special crops program at the CDCS is primarily responsible for the evaluation, introduction, and development of new crops for southern Alberta through applied and adaptive research projects. Some study projects are conducted in collaboration with other research programs at CDCS, other divisions of AAFRD, U of A, U of S, AAFC, Applied Research Associations and industry partners. Different funding sources such as Agriculture Funding Consortium, regional variety testing programs and also several industry partners provide the financial support for the program.

RESEARCH STUDY PROJECTS

Chickpea and lentil crop improvement project

In 2001, a five-year crop improvement project for chickpea and lentil was initiated at the CDCS in collaboration with the Crop Development Centre, U of S, where F1 and F2 generations of both crop species are raised. The main objective of this project is to develop new chickpea and lentil cultivars for southern Alberta under dryland conditions with specific selection criteria of high seed yield, early flowering early and uniform maturity, resistance to common foliar and root diseases, and desired market traits.

The chickpea trials at Saskatchewan site were not harvested due to frost damage prior to crop maturity. However, Alberta trials were harvested as planned and data were collected. On average, the crop maturity ranged from 97 days (desi line 381-4 and 381-18) to 105 days (kabuli cultivar Sanford) and seed yields ranged from 2222 kg/ha (Sanford) to 3902 kg/ha (CDC Frontier). None of the F2:6 kabuli lines produced significantly heavier seed than that of Sanford or CDC Frontier. However, based on crop growth and development, crop maturity, seed quality and size, and seed yield, six F2:6 lines (three desi and three kabuli) were selected for further evaluation and selection in 2005

Three separate studies were conducted using seed of F2:5 generation at 2 test sites (CDCS, Brooks and Bow Island Sub Station) with 2 replicates at each site.

Study 1: This study included 10 lines (8 red and 2 green) and 4 cultivars (CDC Redberry, CDC Robin, Sovereign and Laird). Days to crop maturity, 1000-seed weight and seed yield were determined. On average, crop maturity varied from 79 days (1900-4, 1881-7 and CDC Robin) to 88 days (Laird) and seed yield varied from 1286 kg/ha (CDC Robin) to 2252 kg/ha (CDC Redberry). Based on these overall evaluations, 2 lines from each red and green lentil group were selected for further evaluation in 2005.

Study 2: Seventeen 17 red lentil lines and 2 cultivars (CDC Redberry and CDC Robin) were evaluated at two test sites (CDCS, Brooks and Bow Island Sub station) with 2 replicates at each site. On average, crop maturity varied from 79 days (2120 S-3) to 87 days (CDC Redberry) and seed yield varied from 1391 kg/ha (2120 S-3) to 2378 kg/ha (1967 S-5). Based on overall evaluation, 8 red lentil lines were selected for further evaluation in 2005.

Study 3: The same test sites were used as in Study 1, using 17 small green lentil lines and 2 cultivars (Milestone and Eston). Crop maturity varied from 77 days (1986 S-4 and 1987 S- 16) to 81 days (1986 S-3) and seed yield varied from 1057 kg/ha (1984S-1) to 1821 kg/ha (1887T-4). Based on overall evaluations, 5 small green lentil lines were selected for further evaluation in 2005.

Six F2:6 lentil lines and 2 cultivars (CDC Redberry and CDC Robin) were grown at 4 locations in Alberta (Brooks; Bow Island Sub Station, Bow Island grower's site and Oyen) and two sites in Saskatchewan (Goodale and SPG Research Farms, near Saskatoon), with two replicates at each location. The trials at all test sites were harvested. On average, crop maturity varied from 80 days (P4-2) to 84 days (CDC Redberry) and seed yield varied from 1414 (CDC Robin) to 1737 kg/ha (P5-2). Based on evaluations, 3 lines selected for further evaluations in 2005.

Plant population density of all of the fall-seeded, uncoated seed at the recommended seeding rate was comparable with that of the fall seeded plastic polymer coated treatment.

Fall vs. spring seeding of desi chickpea

Fall seeding, or dormant seeding, refers to the planting of spring crop species in the fall, prior to freeze up the ground. A field study was conducted in 2003/2004 cropping season at CDCS, using the desi chickpea cultivars Myles and small-seeded kabuli cultivar CDC Chico. Treatments included one seeding date in late fall (October 28, 2003) and two seeding dates in early spring (April 27 and May 20, 2003). Seeding of fall-seeded treatment was carried out using 1 and 1.5 times the recommended seeding rates for uncoated seed and the recommended seeding rate for plastic polymer-coated (Grow Tec Inc. Edmonton, Alberta, Canada) seed treatment. The recommended seeding rate was used for the spring-seeded treatments.

On average, CDC Chico plants were significantly taller than Myles plants. Moreover, fall-seeded crops were significantly taller than the spring-seeded crops. On average, CDC Chico produced a significantly heavier seed than Myles. Late spring-seeded crop produced significantly heavier seed than early spring-seeded crop. Irrespective of seed coat treatment or seeding rate, fall-seeded crop produced seed with comparable weights. Increasing seeding rate of fall-seeded treatments from 1x recommended rate to 1.5 x recommended rate did not increase plant density or seed yield. On average, plant population density of the fall-seeded, uncoated seed at recommended seeding rate was comparable with that of the fall-seeded plastic polymer seed coat treatment, which was about 42% of the plant population of the early spring-seeded crop.

This indicates that the plastic polymer seed coat treatment had no beneficial effect on seedling establishment of the fall-seeded chickpea crop. Despite that, among fall-seeded treatments, seed coat treatment produced a significantly higher seed yield compared to the uncoated treatment with 1 x recommended seeding rate.

On average, Myles produced a significantly higher seed yield than CDC Chico. The earlier spring-seeded crop produced about 40 % higher seed yield than the later spring-seeded crop.

On average, plants from the fall-seeded treatments of both cultivars flowered and attained maturity 15 days and 28 days, respectively earlier than the early spring–seeded crop. Lower plant density and seed yield of CDC Chico, compare to Myles mainly due to poor over wintering ability of the CDC Chico crop. Thus, further studies are required to elucidate the factors affecting over wintering ability of chickpeas.

Impact of seed size planted on crop phenology and seed yield

There was a difference in crop maturity and seed yield among cultivars, but size of seed planted had no impact on crop maturity within each cultivar.

The size of the seeds planted has been shown to have a significant impact on seedling establishment, seedling vigor and crop growth of several small-seeded field crops such as canola, mustard, coriander and carrot. Conversely, other studies have revealed that the seed size had no significant impact on plant growth, development and seed yield of large-seeded crops such as chickpeas. Two studies were conducted at CDCS to examine the effect of size of seeds planted, on seedling growth, seed yield and seed size profile of the resulting crop of 4 kabuli chickpea and 4 pinto bean cultivars at CDCS.

Kabuli chickpeas

Three large-seeded kabuli chickpea cultivars, Sanford, Evans and CDC Xena, and one small-seeded kabuli cultivar, CDC Chico were used for this study. Seed of each chickpea cultivar were screened into two size categories, for large-seeded cultivars, <8.7 mm and >8.7mm, and small-seeded cultivar, < 8.1, and > 8.1 mm. These treatments (cultivar x seed size) were seeded at the recommended seeding rate (55 seeds m-2). In addition, another treatment using smaller seed category of all chickpea cultivars at 1.4 x recommended seeding rate was included.

The chickpea cultivars differed in plant height, seed yield components and seed size distribution, but the size of seed planted had no significant impact on most of these parameters. The large-seeded chickpea cultivars, Sanford and Evans were taller than the large-seeded cultivar CDC Xena and the small-seeded cultivar CDC Chico. All three large-seeded cultivars flowered simultaneously, but 6 days later than CDC Chico. On average, CDC Chico matured at least 4 days earlier than the large-seeded chickpeas. All three large-seeded chickpea cultivars produced fewer seeds plant-1, compared to CDC Chico. Despite these phenological differences, the lack of a significant impact of seed size planted, on plant growth, seed yield components and seed yield suggests that smaller seed of kabuli chickpea can be used for planting without affecting seed yield or the seed size profile of the resulting crop. Moreover, the use of smaller seed category at higher seeding rate (1.4 x recommended seeding rate) had no significant effect on seed yield. This assumes the reduction in seed size not due to disease infected seed or immature seed. If smaller seed category is used for planting purpose, the grower could reduce their seed cost due to reduced seeding rate and transportation cost. At the same time, the larger seed portion of the crop can be sold at a premium for human consumption.

Pinto bean

The seeds of the four cultivars (Othello, Fargo, CDC Pintium and CDC Pinnacle) were screened into four size categories (<7.1 mm, 7.1-7.9 mm, 7.9-8.7 mm and > 8.7 mm in diameter). These seed categories of the 4 bean cultivars were seeded at the recommended seeding rate (55 seeds m-2). In addition, a treatment using the 7.1 –7.9 mm seed category at 1.3 x recommended seeding rate was also included.

Pinto bean cultivars differed in plant height, mean seed weight, seed density, and seed yield. On average, CDC Pinnacle and Fargo produced the tallest plants whereas Othello produced the shortest plants. Regardless of cultivar or size of seed planted, all the bean cultivars flowered on July 23, 2004. There was a difference in crop maturity among cultivars, but size of seed planted had no impact on crop maturity. Among bean cultivars, CDC Pintium matured earliest (102 days after seeding) whereas CDC Pinnacle matured latest (119 days after seeding). Both Othello and Fargo matured 116 days after seeding. On average, CDC Pinnacle produced the heaviest seed and Othello produced the lightest seed. On average, the size of seed planted had no significant impact on seed yield, final plant height, test weight or plant population density. These results indicate that smaller seed categories can be used for seed purpose without having any adverse impact on seed yield, while larger seed categories can be used for human consumption purpose. Moreover, use of the 7.1 –7.9 mm seed category at 1.3 x recommended seeding rate had no benefit to seed yield of the resulting crop.

Evaluation of rosemary as a potential medicinal plant for Alberta

Rosemary (*Rosmarinus officinalis* L.), a member of the Labiateae or mint family, is a slow growing, cold sensitive, woody perennial cultivated for its aromatic foliage. The crop is used primarily as a culinary herb with meats, vegetables and in soups. In traditional medicine, the plant is used as an astringent and diuretic, and to increase menstrual flow. Interest has been increased in using rosemary extracts as a source of phenolic compounds, which possess antioxidant properties that can be used in commercial food preparations. Norac Technologies, a division of Newlywed Foods in Edmonton, AB is currently extracting antioxidants from leaves of imported rosemary, using a supercritical fluid extraction method. Preliminary studies conducted at the CDCS indicated that rosemary plants produced under field conditions are superior in antioxidant content than imported rosemary. Norac Technologies is interested in using this high quality locally grown rosemary for their processing. This will require a detailed economic, risk, and logistic analysis of the cost and methods of production, screening of potential cultivars for foliage yield and antioxidant content.

The leafiness of the rosemary plant is more important that the total aboveground biomass production.

Several field studies were conducted :

·To assess the possibilities of growing rosemary as an annual crop under field conditions in southern Alberta

·To evaluate the impact of freezing temperatures exposed in the field, and killing frost on plant growth and antioxidant content in rosemary

·To evaluate effect of age of the rooted stem cutting planted in field, on growth and productivity of rosemary

·To evaluate the effect of planting density and soil nitrogen content on plant growth, productivity and product quality of rosemary

Field study 1. Rosemary cultivar evaluation for plant growth, foliage production and phenolic compound content.

This study was conducted using 8-week-old rooted stem cuttings of eleven promising rosemary cultivars namely: Arp, Barbeque, Majorca, Pink Majorca, Rex, Santa Barbara, Severn Seas, Standard, Blue Lagoon, Primely Blue and unnamed cultivar.

The phenolic compound extractions and quantification are being performed at Norac Technologies, Edmonton, AB, Canada.

Rosemary cultivars differed in plant growth. Cultivars Arp, Barbeque, Rex and unnamed cultivar were produced taller plants with larger diameters. After being exposed to the freezing temperatures in the field, the plant growth of all the rosemary cultivars appeared to be arrested. However, impact of freezing temperature and killing frost on total phenolic content is still being investigated. The analysis of those compounds is in progress. In rosemary, foliage portion is the most important plant part since it contains over 85% the total antioxident content (TA = total activity). The leafiness (dry weight ratio between foliage portion and the total above ground portion) is more important than the total aboveground biomass production. Among the tested cultivars, Rex produced the highest (28.9 g DW/plant) and unnamed cultivars produced the second highest (25.1 g DW/plant) foliage biomass. Cultivars Barbeque, Standard and Primely Blue produced comparable foliage yields, but all were significantly lower than that of Rex. However, promising cultivars will be selected based on the productivity of phenolic compounds (phenolic compound % x foliage dry matter yield), once the phenolic compound analyses are complete.

Study 2: Effect of nursery age of rooted stem cutting on plant growth and foliage production in rosemary

This study was conducted to evaluate the impact of age of rooted stem cutting on plant growth, productivity and total phenolic content of rosemary cultivar Majorca using 4-, 6- and 8-week-old rooted stem cuttings.

Results indicated that age of rooted stem cutting had no significant impact on plant height and diameter, but an increasing trend in both total biomass and leaf production was observed as the length of rooting period increases from 4 weeks to 8 weeks. However, the trend was not statistically significant. Thus, these results suggest that 4-week-old rooted stem cuttings can be used as a planting material for field production of rosemary. However, further studies are required to examine effective means for accelerated root growth of rosemary stem cuttings during the nursery period.

Four-week or six-week old rooted stem cuttings can be used as a planting material for field production of rosemary.

Study 3. Effect of plant population density and soil nitrogen content on plant growth and total phenolic compound content of rosemary.

This study was conducted to evaluate the effect of plant population density and soil nitrogen content on crop growth and total phenolic compound content of rosemary cultivars Majorca and Rex.

The two rosemary cultivars used in this study were significantly different from each other in terms of biomass production (total and foliar), but not in plant height or lateral growth measured through plant diameter. Planting space (population density) had a significant impact on biomass production and plant diameter, but not on plant height.

The highest leaf production and antioxidant yield were observed from the plants grown at a spacing 30 cm x 20 cm at 50 N kg ha-1 and increasing N rates from 50 to 100 N kg ha-1 had no beneficial effect on either leaf production or antioxidant production.

Evaluation of chicory cultivars and timing of harvest for the production of inulin in southern Alberta

Chicory (*Cichorium intybus*) is a perennial plant belonging to the Asteraceae (sunflower) family. Chicory roots contain relatively high levels of inulin and fructo-oligosaccharides, which have been shown to have prebiotic effects such as enhancing the growth of lactobacillus in the human intestine which can improve the balance of the beneficial bacteria in the bowel. Chicory is a relatively new commercial crop to North America, thus information on cultivars with high quality inulin content, and cultural practices for root production on the Canadian prairies is lacking. A study was conducted at three locations, Brooks, Bow Island, and Taber, using six chicory cultivars; Arancha, Beryl, Maurane, Orchies, Magdeburg and Turquoise, to examine the adaptability and productivity of the chicory cultivars, as well as the impact of date of harvest and storage period on root inulin content and quality. At the Taber site, all the cultivars but Magdeburg were included.

Maurane and Orchies are the best chicory cultivars for higher fructan production in southern Alberta. For maximum fructan yield, the root should be harvested in mid October.

At all three locations, date of harvest and cultivar produced a significant impact on root and total fructan yields of chicory crop. In addition, storage period significantly influenced the moisture and fructan content of chicory roots. The total biomass (foliage and root fresh weight) yields of chicory cultivars were determined at Brooks and Bow Island. At Taber, only the root yields were determined.

In summary, Maurane and Orchies are the best chicory cultivars for higher fructan production in southern Alberta, and for the maximum fructan yield, the root should be harvested in mid October. Late-harvested roots (more mature roots) are much more suitable for storage than early harvested roots. The quality analysis of inulin (degree of polymerization) is in progress at the Olds College School of Innovation, (Olds, Alberta) and results will be available in late March.

Crop selection and improvement

The seed of *Echinacea angustifolia*, *E. pallida, E purpurea* and borage and the stolons of peppermint, spearmint and Alaskan mint were treated with mutagenic compound, Ethyl Methanesulphonate (EMS) in 2000. Treated seeds and stolons were planted in plugs or pots and placed in a greenhouse. In early spring, both Echinacea and mint species were transplanted in the field. Echinacea species are being visually evaluated for aster yellows disease resistance and medicinal quality. The mint species are being evaluated for over wintering ability and essential oil contents. Foliage of individual mint plants raised from the treated stolons was used to extract essential oil and crop selection based on essential oil content, oil composition and over-wintering ability is in progress.

The seed harvested from borage plants from EMS-treated seed were planted in spring 2004 in the field for selection and seed multiplication. Based on maturity, borage plants were categorized into several groups and further selection is in progress based on seed shattering, and seed oil content.

Regional cultivar evaluations

Newly recommended cultivars and promising lines of chickpeas, dry beans, field peas, lentils and fababean received from various pulse breeding programs are evaluated under growing conditions in southern Alberta, to select the most promising cultivars for the region.

The emphasis of the dry bean cultivar testing is on yield performance, early maturity and architecture of a dry bean plant that allows for narrow row configurations, direct combining and consequently an expansion of dry bean production to areas in Alberta. Majority of bean cultivars/lines for this evaluation receives from the dry bean crop improvement programs at AAFC - Lethbridge and the CDC at the U of S.

Two field pea cultivar evaluation studies were conducted at CDCS and Bow Island sub station, to evaluate varieties/lines for regional adaptation. At both test sites, under rain-fed conditions, 7 green pea cultivars/lines produced comparable seed yields ranging from 1750 to 2013 kg/ha in Brooks and 1066 to 1281 kg/ha at Bow Island. Among the 17 yellow field pea cultivar/lines evaluated, DS Admiral (1848 kg/ha) and Eclipse (1830 kg/ha) produced the highest seed yield at Brooks, and Eclipse (3887 kg/ha) and CDC Mozart (3666 kg/ha) produced the highest seed yield at Bow Island.

Different lines and registered varieties of other pulse crops, such as chickpeas, lentils, soybeans and faba beans were evaluated for regional adaptation. Two chickpea tests were established at CDCS and the Bow Island. Among the 13 cultivars evaluated, CDC Desiray and Sanford produced the highest seed yields at Bow Island and CDC Frontier and Amit produced the highest seed yields at Brooks. Among the 7 large seeded lentil lines evaluated, CDC Vantage and Laird produced the highest seed yield at Brooks and CDC Plato and CDC Vantage produced highest seed yield at Bow Island. Among the red lentils, CDC Redberry and line 1145-3-6 produced the highest seed yields at Brooks, and CDC Viceroy and Redberry produced the highest seed yields at Bow Island. Two soybean tests were established at Brooks (rain-fed) and Bow Island (irrigated), using 9 cultivars received from the oilseed breeding program at Agriculture Canada Research Station in Ottawa. Soybean cultivars Gentleman, AC Orford and OAC Prudence produced highest yield among the cultivars tested. Seven faba bean cultivars were evaluated under irrigated conditions at Bow Island sub station. Among the cultivars tested, Earlibird, Scirocco and Ben produced the highest seed yields.

Several cultivars/lines of silage and grain corn were established for regional adaptation. Both silage and grain corn performed very well under both Bow Island and Brooks growing conditions.

Evaluation of new pulse crop species

Seed of unnamed and named lines of mung bean (*Vigna radiata* L. Wilczek), black gram (*Vigna mungo* L. Hepper.), moth bean (*Vigna aconitifolia*) and pigeon pea (*Cajanus cajan* L. Millisp) were planted in the research field at CDCS in mid May, 2004. Crop maturity was challenged by cool and wet growing season so that only moth bean and black gram were able to harvest in 2004. Further evaluation and selection will be conducted in 2005.

EXTENSION AND INDUSTRY DEVELOPMENT ACTIVITIES

Program staff continued to answer numerous inquiries on the production of special crops, particularly on herb, spice and essential oil crops. Several field days and workshops were organized and research information was contributed on special crops to producer newsletters and the news media. Test plots of various special crops including pulse crops and medicinal herbs at CDCS and Bow Island were visited by a large number of interested individuals and groups. Extension staff and other interested parties were provided with planting materials for demonstration and field testing to assist herb, essential oil and spice producers evaluate new crops and to develop agronomic practices.

WEATHER
BROOKS

Nigel Seymour

CDCS operates two automated weather stations; one at the Centre southeast of Brooks and another at the sub-station southwest of Bow Island.

Brooks (CDCS)

Precipitation is measured with two instruments at the Brooks station. The Tipping Bucket Rain Gauge (TBRG) very accurate in reading rainfall to 0.2 mm is not reliable for recording snowfall. The Fischer-Porter Weighing Gauge (F&P) provides an accurate reading for snowfall equivalent. 2004 was a dry year for the Brooks area compared with the thirty year average but for the growing period (May to August) there was above average rainfall for the period

The final spring frost of 2004 occurred on May 24 (-2.6/C). The first autumn frost was –0.5/C on September 20 (-3.6/C on Septembr 21), giving a total of 118 frost-free days in 2004. This is 2 days more than the 30-year average (1951-80) of 116 frost-free days (May 21 to September 15).

118 frost-free days in 2004, 2 more than the 30-year average.

	Temperatures (^{0}C)								Precipitation (mm)		
	Extremes		Average				Means		2004		1971-2004
	Min	Max	Max	30 yr Av	Min	30 yr Av	2004	30 yr Av	TBRG	F&P	30 yr av
January	5.6	-32.9	-5.6	-5.6	-16.9	-17.0	-12.7	-11.3	n/a	6.7	14.7
February	5.6	-30.9	-2.7	-2.7	-13.4	-14.1	-7.6	-8.4	n/a	0.6	12.2
March	26.6	-19.7	3.7	3.7	-4.1	-7.8	1.7	-2.1	n/a	6.2	19.5
April	26.2	-6.4	12.7	12.7	-1.5	-1.7	6.9	5.5	14.0	13.9	27.9
May	25.2	-4.9	18.9	18.9	2.6	4.2	9.5	11.6	36.4	36.6	44.1
June	29.8	1.2	23.1	23.1	7.3	8.8	14.2	16.0	64.8	60.4	58.8
July	35.6	7.6	25.7	25.7	11.1	10.9	18.6	18.3	37.6	32.2	41.7
August	31.2	4.3	25.0	25.0	9.9	9.7	16.6	17.4	67.0	67.4	39.3
September	24.6	-5.9	18.8	18.8	3.7	4.2	11.0	11.5	8.6	8.3	39.4
October	25.3	-9.2	13.6	13.6	-2.6	-1.1	4.7	6.3	5.4	4.5	17.0
November	20.9	-15.5	1.9	1.9	-6.9	-9.7	0.7	-4.0	n/a	1.4	14.7
December	15.6	-29.3	-4.2	-4.2	-13.3	-15.7	-6.8	-9.9	n/a	14.3	18.9
Average	22.7	-11.8	10.9	10.9	-2.0	-2.4	4.7	4.2	Tot n/a	252.5	348

WEATHER BOW ISLAND

NIGEL SEYMOUR

128 frost free days in 2004, 3 days more than the 30-year average.

The last recorded frost was –1.3/C on May 24 and the first autumn frost (-0.8/C) occurred on September 30, for a total of 128 frost-free days in 2004, three days more than the 30-year average (1951-80) growing season at Bow Island of 125 days (May 17 to September 20).

The precipitation recorded during the summer months indicates lower than average moisture for the growing season in Bow Island except for August which had nearly twice the average precipitation for that month. It is important to note that precipitation is only measured with a tipping Bucket Rain Gage which is unreliable during the winter months.

	Temperatures (^{0}C)								Precipitation (mm)	
	Extremes		Average				Means		2004	1971-2004
	Min	Max	Max	30 yr Av	Min	30 yr Av	2004	30 yr Av	TBRG	30 yr av
January	6.5	-32.9	-6.8	-5.2	-15.4	-15.9	-11.1	-10.6	1.8	18.6
February	7.2	-27.4	-0.9	-0.9	-10.2	-11.7	-5.6	-6.3	1.8	11.3
March	25.4	-20.1	8.8	4.7	-2.7	-6.6	3.1	-0.9	53.9	13.1
April	25.3	-5.2	15.2	12.5	-0.4	0.2	7.4	6.6	11.9	34.2
May	24.3	-2.6	15.8	19.2	3.4	5.5	9.6	12.4	41.7	44.9
June	29.4	2.1	20.8	24.4	7.4	10.7	14.1	17.6	36.1	69.8
July	32.8	5.5	26.0	27.6	11.3	12.1	18.6	19.7	26.2	30.9
August	31.1	5.4	23.7	27.1	10.4	11.9	17.0	19.6	60.6	32.4
September	27.1	-3.1	18.8	20.2	4.8	5.6	11.8	12.9	12.6	30.4
October	25.7	-7.2	12.9	15.0	-1.3	0.5	5.8	7.6	9.6	12.3
November	18.5	-12.7	8.1	4.7	-5.2	-6.6	-1.4	-1.0	3.8	12.8
December	15.2	-29.4	1.9	-2.8	-10.5	-13.0	-4.3	-7.9	5.3	19.0
Average	22.4	-10.6	12.0	12.2	-0.7	-0.6	5.4		Tot 265.3	330

PUBLICATIONS & PRESENTATIONS

Research Reports

(AARI, Expert Committee on Integrated Pest Management, ECW, CDCS/CDCN program report)

Bains, P.S., Howard, R.J., Mirza, M., Savidov, N.A., Hughes, J.A. Lisowski, S.L.I. and Cote, P.A. 2004. Survey for root and stem diseases in greenhouse cucumber in Alberta. Can. Plant Dis. Surv. 84: 113-114.

Chang, K.F., Bowness, R., Hwang, S.F., Turnbull, G.D., Howard, R.J. and Blade, S.F. 2004. The occurrence of field pea diseases in central and southern Alberta in 2003. Can. Plant Dis. Surv. 84: 104-106.

Howard, R.J., Lisowski, S.L.I., and Slomp, D.L. 2004. Long-term storage of creamer-sized potatoes. Final Report of Project #629038 for the Little Potato Company, Edmonton. 29 pp.

Hwang, S.F., Wang, H., Gossen, G.B., Chang, K.F. and Howard, R.J. 2004. Economic impact and management of leaf spot diseases on forage and seed alfalfa. Final Report of AARI Project #2000M649. 98 pp.

Hwang, S.F., Wang, H., Gossen, G.B., Chang, K.F. and Howard, R.J. 2004. Economic impact and management of leaf spot diseases on forage and seed alfalfa. Final Report for 2000-2003 for AARI Farming for the Future Matching Grants Project 2000-M649. 98 pp.

Konschuh, M.N. and Dalpé, S. 2004. Effect of MH60 for size control in Russet Burbank potatoes. Report for Crompton Co. Research Laboratories, Guelph, ON. 7 pp.

Konschuh, M.N. and Dalpé, S. 2004. Effect of MH60 for size control in a chipping variety. Progress Report for Potato Growers of Alberta, Taber, AB. 7 pp.

Konschuh, M.N., Dalpé, S. and Driedger, D. 2004. Potato vine management with desiccants. Report for Syngenta Crop Protection Canada, Inc., Calgary, AB. 9 pp.

Konschuh, M.N., Dalpé, S. and Woods, S.A. 2004. Awaken product evaluation. Report for United Agri-Products, Dorchester, ON. 8 pp.

Konschuh, M.N., Howard, R., Dalpé, S., and Slomp, D.L. 2004. Syngenta 2004 Federal Research Permit Sites: Maxim MZ on potatoes – southern Alberta. Report for Syngenta Crop Protection Canada, Inc., Guelph, ON. 19 pp.

Konschuh, M.N., Dalpé, S., and Driedger, D. 2004. Timing of power hilling for Russet Burbank in southern Alberta. Report for Potato Growers of Alberta, Taber, AB. 13 pp.

Konschuh, M.N., Meers, S. and Vernon, B. 2004. Evaluation of products for wireworm control on irrigated potatoes in southern Alberta. Report for Gustafson and Syngenta Crop Protection Canada, Inc., Calgary, AB. 4 pp.

In 2003 Pest Management Research Report - Insects and Plant Diseases. Expert Committee on Integrated Pest Management, Agriculture and Agri-Food Canada. Ontario. January, 2004.

> **Chang, K.F., Bowness, R., Hwang, S.F., Turnbull, G.D., Howard, R.J. and Lopetinsky, K.** 2004. Evaluation of fungicidal seed treatments for the control of rhizoctonia and fusarium seedling blight of faba bean in Alberta in 2004.
>
> **Chang, K.F., Bowness, R., Hwang, S.F. Turnbull, G.D., Howard, R.J. and Lopetinsky, K.** 2004. Evaluation of fungicidal seed treatments for the control of rhizoctonia and fusarium seedling blight of lupine in Alberta in 2004.

Howard, R.J., Burke, D.L., Pugh, S.L., Chang, K.F., Bowness, R.T., Hwang, S.F., Turnbull, G.D., and McGregor, W.R. 2004. Efficacy of foliar fungicides against ascochyta blight of chickpea.

Howard, R.J., Burke, D.L., Pugh, S.L., Esau, R., Basu, K., Labun, T.J. and Greenough, G. 2004. Tolerance of turnip rapeseed to Helix liquid seed treatments.

Howard, R.J., Burke, D.L., Pugh, S.L., Labun, T.J. 2004. Apron Maxx RTA seed treatment research permit trial on chickpea for the control of damping-off and root rot, 2003.

Howard, R.J., Burke, D.L., Pugh, S.L., Labun, T.J. 2004. Apron Maxx RTA seed treatment research permit trial on dry bean for the control of damping-off and root rot, 2003.

Hwang, S.F., Turnbull, G.D., Chang, K.F. and Howard, R.J. 2004. Evaluation of fungicidal seed treatments for the control of rhizoctonia seedling blight of field pea in Alberta in 2004.

Hwang, S.F., Turnbull, G.D., Chang, K.F. and Howard, R.J. 2004. Evaluation of fungicidal seed treatments for the control of seedling blight of alfalfa caused by *Rhizoctonia solani* and *Fusarium avenaceum* in Alberta in 2004.

Hwang, S.F., Turnbull, G.D., Chang, K.F. and Howard, R.J. 2004. Evaluation of fungicidal seed treatments for the control of seedling blight of birdsfoot trefoil caused by *Rhizoctonia solani* and *Fusarium avenaceum* in Alberta in 2004.

Hwang, S.F., Turnbull, G.D., Chang, K.F. and Howard, R.J. 2004. Evaluation of fungicidal seed treatments for the control of seedling blight of sweet clover caused by *Rhizoctonia solani* and *Fusarium avenaceum* in Alberta in 2004.

Hwang, S.F., Turnbull, G.D., Chang, K.F. and Howard, R.J. 2004. Effects of fungicidal seed treatments for the control of rhizoctonia seedling blight of canola in Alberta in 2004.

Hwang, S.F., Turnbull, G.D., Chang, K.F. and Howard, R.J. 2004. Effects of fungicidal seed treatments for the control of rhizoctonia seedling blight of canola in Alberta in 2004.

Hwang, S.F., Turnbull, G.D., Chang, K.F. and Howard, R.J. 2004. Effects of fungicidal seed treatments for the control of fusarium seedling blight of canola in Alberta in 2004.

Wang H., Hwang, S.F., Turnbull, G.D., Chang, K.F. and Howard, R.J. 2004. Evaluation of seed piece treatments for the control of fusarium seed piece decay of potato in Alberta in 2004.

McKenzie, R.H. and Middleton, A.B. 2004. Development of agronomic practices for chickpea production. Final Report for AARI.

McKenzie, R.H. and Middleton, A.B. 2004. Optimizing malt barley production. Final Report.

McKenzie, R.H. and Middleton, A.B. 2004. Optimizing mustard production. Final Report for AARI.

Murray, C.L. and Seymour, N.G. 2004. Nursery Crops Program 2003. #2004-8. March

Murray, C.L. and Seymour, N.G. 2004. Nursery Crops Program 2004. #2003-8. <http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/opp8328?opendocument>

Pfiffner, P.G., McKenzie, R.H. and Middleton, A.B. 2004. Long-term crop rotation study in the Brown Soil Zone. 2004 Summary Report.

Pfiffner, P.G., Middleton, A.B., and McKenzie, R.H. 2005. The effect of irrigation and nutrient management on yield and quality of timothy hay. 2004 Summary Report for ACIDF.

Najda, H. and Kruger, A. 2004. Western forage testing system report. 106 pp.

Najda, H. and Kruger, A. 2004. Western Canadian grass seed testing program. Annual Report. 40 pages.

Neeser, C., Pheh, T. and Webber, M. 2004. Vegetable Research Update 2003, Jan. 16, 2004. www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/opp7982?opendocument

Neeser, C., Howard, R., Slomp, D., Burke, D., Pheh, T., and Webber, M. 2004. Evaluation of some common biofertilizers and soil inoculants in romaine lettuce. AAFRD/CDCS, Brooks AB, 6 pp.

Abstracts and Papers in Refereed Journals

Ahmed, H.U., Chang, K.F., Hwang, S.F., and Howard, R.J. 2004. Response of a field population of *Ascochyta rabiei* to various dosages of chlorothalonil and mancozeb. Can. J. Plant Pathol. 26: 404 (Abstr.).

Chang, K.F., Ahmed, H.U., Hwang, S.F., and Howard, R.J. 2004. Evaluation of chickpea for resistance to ascochyta blight using detached-leaf and spray inoculation methods. Can. J. Plant Pathol. 26: 407 (Abstr.).

Chang, K.F., Hwang, S.F., Gossen, B.D., Turnbull, G.D., Howard, Howard and Blade, S.F. 2004. Effects of soil temperature, seeding depth, and seeding date on rhizoctonia seedling blight and root rot of chickpea. Can. J. Plant Science 84: 901-907.

Chang, K.F., Hwang, S.F., Khadhar, A.H., Kawchuck, L.M., Turnbull, G.D. and Howard, R.J. 2004. Occurrence of aster yellows phytoplasma in chai hu in Alberta, Canada. J. Plant Disease and Protection 111(3): 218-224.

Chang, K.F., Hwang, S.F., Khadhar, A.H., Kawchuck, L.M., Turnbull, G.D. and Howard, R.J. 2004. Detection and molecular characterization of an aster yellows phytoplasma in poker statice and Queen Anne's Lace in Alberta, Canada. Microbiological Research 159: 43-50.

Fraser, J., McCartney, D., Najda, H. and Mir, Z. 2004. Yield potential and forage quality of annual forage legumes in southern Alberta and northeast Saskatchewan. Can. J. Plant Sci. 84: 143-155.

Hwang, S.F., Chang, K.F., Gossen, B.D., Turnbull, G.D., and Howard, R.J. 2004. Effects of seeding conditions and seed quality on rhizoctonia seedling blight and seed yield of lentil. Can. J. Plant Pathol. 26: 226 (Abstr.).

Hwang, S. F., Su, H., Chang, K. F., Blade, S.F., Turnbull, G. D., and Howard, R.J. 2004. Characterization of the metabolites produced by *Mycosphaerella pinodes*, a causal agent of ascochyta blight on field pea (*Pisum sativum* L.). Microbiological Research 159: 187-192.

Hwang, S.F., Zhang, R., Chang, K.F.,Gossen B.D. and Turnbull, G.D. 2004. Comparison of three methods for assessing reaction to *Mycosphaerella pinodes* in lines of *Pisum sativum*. Can. J. Plant Pathol. 26: 414.

Lynch, D. R., Kawchuk, L.M., Chen, Q., Konschuh, M., Holley, J., Fujimoto, D.K., Driedger, D.,Wolfe, H., Dunbar, L., Waterer, D., Bains, P., Wahab,J., and McAllister, P. 2004. Alta Russet: An early maturing, high-quality russet cultivar for wedge-cut French fry production. Am. J Potato Res. 81: 195 – 201.

Lynch, D. R., Kawchuk, L.M., Chen, Q., Wahab, J. M. Konschuh, Waterer, D., Holley, J., Fujimoto, DK., Driedger, D.Wolfe, H., Dunbar, L., Bains, P., and McAllister, P. 2004. Pacific Russet: An early maturing, attractive russet cultivar with excellent culinary quality. Am. J Potato Res. 81: 235 – 241.

McKenzie, R.H., Middleton, A.B., DeMulder, J. and Bremer, E. 2004. Fertilizer response of barley silage in southern and central Alberta. Can. J. Soil Sci. 84:133-147.

McKenzie, R.H., Middleton, A.B., Flore, N. and Bremer, B. 2004. Evapotranspiration efficiency of pea in south and central Alberta. Can. J. Plant Sc. 84:463-471.

McKenzie, R.H., Middleton, A.B., Hall, L., DeMulder, J. and Bremer, E. 2004. Fertilizer response of barley grain in southern and central Alberta. Can. J. Soil Sci. 84:513-523.

Su, H., Hwang, S.F. Chang, K.F., Conner, R.L., Howard, R.J., Turnbull, G.D., and Blade, S.F. 2004. Difference in the growth stages of Erysiphe pisi on cultivars of field pea (*Pisum sativum* L.) J. Plant Disease and Protection 111: 64-70.

Walburger, A.M., McKenzie, R.H., Seward, K., and Ulrich, K. 2004. The economics of sustainable agriculture alternatives on the semiarid Canadian prairies: The case for legumes and organic amendments. J. of Sustainable Agriculture 24: 51-69.

Wang, H., Hwang, S.F., Chang, K.F., Gossen, B.D., Turnbull, G.D., and Howard, R.J. 2004. Assessing resistance to spring black stem and leaf spot of alfalfa caused by *Phoma* spp. Can. J. Plant Science 84: 311-317.

Wang, H., Hwang, S.F., Chang, K.F., Turnbull, G.D., and Howard, R.J. 2004. In vitro study of host-plant specificity of *Rhizoctonia solani* in Alberta. Can. J. Plant Pathol. 26: 427 (Abstr.).

Wang, H., Hwang, S.F., Chang, K.F., Turnbull, G.D., and Howard, R.J. 2004. Seed-applied fungicide treatments for controlling fusarium seed piece decay of potato in Alberta. Can. J. Plant Pathol. 26: 230 (Abstr.).

Yang, Y., Chang, K.F., Hwang, S.F., Callan, N.W., Howard, R.J. and Blade, S.F. 2004. Biological Control of Pythium Damping-off in *Echinacea angustifolia* with *Trichoderma* species. J. Plant Disease and Protection 111: 126-136.

Yang, R.C, Ye, T.z., Blade, S.F. and Bandara M. 2004. Efficiency of spatial analyses of field pea variety trials. Crop Sci. 44:49-55

Extension Publications

(internet publications, bulletins, factsheets, compact discs, industry newsletters and pamphlets)

Kharbanda, P.D., Howard, R.J., and Mirza, M. 2004. Internal fruit rot : A new disease of greenhouse pepper in Alberta. Alberta Research Council, Vegreville, AB

Konschuh, M.N. and Dalpe, S. 2004. Timing of Power Hilling for Russet Burbank Potatoes in Southern Alberta, 2003. Pamphlet developed for PGA breakfast meeting, March 19.

Konschuh, M.N. 2004 Evaluation of products for wireworm control on irrigated potatoes in southern Alberta. Information sheet developed for PGA Field Day, July 14.

Mundel, H.-H., Blackshaw, R.E., Byres, R., Huang, H. C., Johnson, D.L., Keon, R., McKenzie, R.H., Otto, B., Roth, B., and Sandford, K. 2004. Safflower Production on the Canadian Prairies. Agriculture and Agri-Food Canada. Catalogue No. A42-101/2004E. 36 pp

Najda, H., Cole, D., Wong, D., Yoder, C., Fairey, N., Coulman, B., Gossen, B., Soroka, J., Huebner, G., Watts, M. and Tremblay, M. 2004. Perennial ryegrass seed production in western Canada. April. AAFRD Agri-Facts. Agdex 127/20-1. 15 pp.

Najda, H. and Kruger, A. 2004 (revised). Cereal silage yield performance under irrigation at Brooks, Alberta. AAFRD Agri-Facts. Agdex 110/32-1. 5 pp.

Neeser, C. 2004. Managing nightshade in peas. AVG(Processing) Newsletter, April, p. 7.

Neeser, C. 2004. Herbicides to control nightshade in peas. AVG(Processing) Newsletter, December, p. 3.

Neeser, C. 2004. Drip irrigation. The Prairie Fruit Journal, vol. 11, issue 1, p. 13.

Neeser, C. 2004. Cover crops and weed management. The Prairie Fruit Journal, vol. 11, issue 1, p. 14.

Neeser, C., Pheh, T. and Webber M. 2004. Comparison of drip and solid set sprinkler irrigation. The Prairie Fruit Journal Vol. 11, issue 2, p 13 – 15.

Pheh, T. 2004. Saskatoon Propagation Part 4. The Prairie Fruit Journal Vol. 11, issue 3, p 10 – 12.

Woods, S.A. 2004. Long-term viability and salinity tolerance of dryland forage and turf grasses. Alberta Agriculture's Ropin' the Web site. <http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/opp7141?opendocument>. July 2003, updated January 2004.

Woods, S.A. 2004. Effects of soil salinity on potatoes. In Lethbridge Irrigation Demonstration Farm: Research Summaries 2003, CACDI. February 2004.

Woods, S.A. 2004. Soil salinity and crop production issues. In Proceedings of the Southern Alberta Conservation Association 10th Annual Dryland and Irrigation Reduced Tillage Conference, Medicine Hat, AB. November/December 2004. p. 16-20.

Yoder, C., Gossen, B., Cole, D., Wong, D., Ropchan, G., Huebner, G., Najda, H., Otani, J., Lickacz, J., Soroka, J., Tremblay, M., Watts, M., Fairey, N., and Burton, S. 2004. Timothy seed production in western Canada. June. AAFRD Agri-Facts. Agdex 127/15-2. 21 pp.

Popular Articles

(magazines, newspapers and other periodicals, e.g. Agri-News)

Bandara. M. 2004. Fenugreek: a multi-purpose crop for Alberta. Agri-News. June 14.

Howard, R.J. 2004. Clubroot was NOT Found in Cruciferous Vegetables in Alberta in 2004. Communication Connection. November 26.

Howard, R.J. 2004. Bronze Leaf Disease of Poplar. Agri-News. July 26.

Konschuh, M.N. 2004. Potatoes, much more than carbohydrates. Potato Minute, Potato Growers of Alberta Newsletter. September 7.

Konschuh, M.N. 2004. Potatoes, much more than carbohydrates. Agri-News. September 13.

Konschuh, M.N. 2004. Potatoes are much more than carbohydrates. Brooks and County Chronicle. September 13.

Konschuh, M.N. 2004. Alberta: potato capital of the west. Brooks and County Chronicle, April 5, 2004.

McKenzie, R.H. Growing Winter Wheat in Alberta. Agri-News. August 2.

Meers, S. 2004. Biography of Scott Meers. Communication Connection. March 5.

Meers, S. 2004. Grasshopper forecast 2004. Agri-News. May 3.

Meers, S. 2004. 2004 leads to largest grasshopper infestation in years. Brooks and Count Chronicle. May 17.

Murray, C.M. 2004. Pulses, Pathology, Potatoes and Greenhouse Vegetables. Agri-News. June 28.

Murray, C.M. 2004. Branch Head Communication Meeting. Communication Connection. July 9.

Murray, C.M. 2004. Canadian Horticulture Council Annual Meeting. Department Information. July 14.

Najda, H. 2004. Southern Alberta update on grass seed production. Forage Seed News. Spring/ Summer. p.12.

Najda, H.G. 2004. Bow Island Substation field day. Agri-News. June 21.

Najda, H.G. 2004. Annual Legumes for Seed Production. Agri-News. September 6.

Najda, H.G. 2004. Southern Alberta update on grass seed production. Forage Seed News. Winter. p.15.

Neeser, C. 2004. Alberta grown carrots are sweet and healthy. Agri-News. June 21.

Neeser, C. 2004. Should you eat more berries? FGSA Newsletter. March.

Neeser, C. 2004. Fruit & Vegetable Research at CDCS. Communication Connection. Dec. 3.

Savidov. N. 2004. Energy workshop for greenhouse growers. Communication Connection. Feb 6.

Savidov. N. 2004. Medicinal Herb Research Seminar. Communication Connection. April 30.

Spencer. R., Howard. R.J., Fry, K. 2004. How to get the jump on greenhouse diseases. Greenhouse Business. May-June.

Posters

Ahmed, H.U.,Chang, K.F., Hwang, S.F., and Howard, R.J. 2004. Response of a field population of Ascochyta rabiei to various dosages of chlorothalonil and mancozeb. Annual Meeting of the Canadian Phytopathological Society, Ottawa, ON, June 13-16, 2004.

Bandara, M., Webber, J. and Fox A. 2004. Impact of fall seeding and seed size on crop growth and seed yield of chickpeas. Dijon, France. June.

Chang, K.F., Ahmend, H.U., Hwang, S.F., and Howard, R.J. 2004. Evaluation of chickpea for resistance to ascochyta blight using detached-leaf and spray inoculation methods. Annual Meeting of The Canadian Phytopathological Society, Ottawa, ON, June 13-16, 2004.

Chang, K.F., Ahmend, H.U., Hwang, S.F., and Howard, R.J. 2004. Manipulation of row spacing and seeding rate for the management of ascochyta blight of chickpea. Annual Meeting of the Plant Pathology Society of Alberta, Lacombe, AB, November 8-10.

Howard, R.J., McFadden, A.G.G., Lisowski, S.L.I., Slomp, D.L., Thompson, B.A., and White, A.C. 2004. Assessing the residual effects of foliar-applied fungicides against three tuber diseases in stored potatoes. Annual Meeting of the Canadian Phytopathological Society, Ottawa, ON, June 13-16, 2004.

Hwang, S.F., Conner, R.L. Chang, K.F. Gossen, B.D., Su, H. Howard, R.J., and Turnbull, G.D. 2004. Seeding conditions: Potential for management of mycosphaerella blight of field pea. Annual Meeting of the Canadian Phytopathological Society, Ottawa, ON, June 13-16, 2004.

Konschuh, M.N. and Dalpé, S. 2004. Timing of power hilling for Russet Burbank in southern Alberta – 1st year. 89th Annual Meeting of the Potato Association of America, Scottsbluff, NE, August 8 – 11.

Konschuh, M.N. and Dalpé, S. 2004. Timing of power hilling for Russet Burbank in southern Alberta – 2nd year. Annual Meeting of the Potato Growers of Alberta, Red Deer, AB, November 17 – 19.

Konschuh, M.N. and Dalpé, S. 2004. Effect of Royal MH60 for size control in chipping potatoes – 2nd year. Annual Meeting of the Potato Growers of Alberta, Red Deer, AB, November 17 – 19.

Howard, R.J., McFadden, A.G.G., Lisowski, S.L.I., Slomp, D.L., Thompson, B.A. and White, A.C. 2004. Assessing the residual effects of foliar-applied fungicides against three tuber diseases in stored potatoes. Canadian Phytopathological Society Meetings. Ottawa, ON. June.

Najda, H. and Kruger, A. 2004. Effect of establishment method on seed yield of irrigated perennial ryegrass. Science of Changing Climates – Impact on Agriculture, Forestry and Wetlands. University of Alberta – Edmonton, Alberta. July 20-23, 2004.

Su, H., Hwang, S.F., Chang, K.F., Conner, R.L. Howard, R.J. Howard, and Turnbull, G.D. 2004. Pathogenic and genetic variation in *Mycosphaerella pinodes* from field peas in Alberta. Annual Meeting of the Plant Pathology Society of Alberta, Lacombe, AB, November 8-10.

Wang, H., Hwang, S.F., Eudes, F., Howard, R.J., and Turnbull, G.D. 2004. Influence of trichothecenes on strain aggressiveness of *Fusarium graminearum* causing seedling blight and root rot in wheat, barley and triticale. Annual Meeting of the Plant Pathology Society of Alberta, Lacombe, AB, November 8-10.

Wang, H., Hwang, S.F., Chang, K.F., Turnbull,G.D. and Howard, R.J. 2004. In vitro study of host plant specificity of *Rhizoctonia solani* in Alberta. Annual Meeting of the Canadian Phytopathological Society, Ottawa, ON, June 13-16, 2004.

Woods, S.A., Hingley, L.E., and Konschuh, M.N. 2004. Petiole Nutrient (N, P and K) Recommendations for Russet Burbank Potatoes Grown in Southern Alberta (2004). Potato Growers of Alberta Annual Meeting, Red Deer, AB. November 2004.

Books

Mundel, H.-H., Blackshaw, R.E, Byers, R., Huang, H. C, Johnson, D.L., Keon, R., McKenzie,R.H., Otto, B., Roth, B., and Sandford, K. 2004. Safflower Production on the Canadian Prairies. Agriculture and Agri-Food Canada. Catalogue No. A42-101/2004E. 36 pp.

Proceedings

Bandara, M., Scharf, F. and Webber J. 2004. Effect of day length and night temperature on cop growth and flowering in four new pulse crop species. Proceedings of the Science of Changing Climates. Inpact on Agriculture, Forestry and Wetlands. U of A., Edmonton AB.July 20-23, 2004. P. 55

Basu., S., Acharya, S., Bandara, M., and Thomas, T. 2004. Agronomic and genetic appoaches for improving seed quality and yield of fenugreen (*Trigonella foenum-graecum* L.) in Western Canada. Proceedings of the Science of Changing Climates. Inpact on Agriculture, Forestry and Wetlands. U of A., Edmonton AB.July 20-23, 2004. P. 38.

Chang, K.F., Ahmed, H.U., Hwang, S.F., and Howard, R.J. 2004. Manipulation of row spacing and seed rate for the management of ascochyta blight of chickpea. Proceedings of the Fifth Canadian Pulse Research Workshop, London, ON, November 29-30. P 31.

Chang, K.F., Bowness, R., Hwang, S.F., Turnbull G.D., Howard, R.J., and Blade, S.F. 2004. Survey of field pea diseases in central and southern Alberta in 2003. Proceedings of the Agronomy Update Conference, Red Deer, AB, January 13-14. P. 172.

Gillard, C.L., Conner, R., Howard, R.J., Pauls, K.P., Shaw, L., and Vandenberg, A. 2004. Field validation of the CBB resistance genes. Proceedings of the Fifth Canadian Pulse Research Workshop Proceedings, London, ON, November 29-30, P. 26.

Hwang, S.F., Conner, R.L. Chang, K.F. Gossen, B.D. Su, H., Howard, R.J. and Turnbull, G.D. 2004. Seeding conditions: potential for management of mycosphaerella blight of field pea. Proceedings of the Fifth Canadian Pulse Research Workshop Proceedings, London, ON, November 29-30. P 33.

Hwang, S.F., Conner, R.L., Chang, K.F., Turnbull, G.D., Blade, S.F., and Howard, R.J. 2004. Effects of seeding rate, seeding depth and seed condition on mycosphaerella blight and seed yield of field pea. Proceedings of the Agronomy Update Conference, Red Deer, AB, January 13-14.

Hwang, S.F., Conner, R.L., Chang, K.F., Turnbull, G.D., Su, H., Gossen, B.D., Howard, R.J. Howard and Blade, S.F. 2004. Effects of seeding depth and seed infection on mycosphaerella blight and seed yield of field pea. Proceedings of the Agronomy Update Conference, Red Deer, AB, January 13-14. P. 161.

McKenzie, R.H. 2004. Optimizing winter cereal production with seeding rate, date, opener type and slow release N fertilizer. Southern Alberta Conservation Association Conference, Medicine Hat, AB. Dec. 1, 2004. Pages 33-43.

Najda, H. and Kruger, A. 2004. Effect of establishment method on seed yield of irrigated perennial ryegrass. In Proceedings of the Science of Changing Climates – Impact on Agriculture, Forestry and Wetlands. University of Alberta – Edmonton, Alberta. July 20-23. p. 50.

Presentations at Professional Meetings, Conferences and Seminars

Bansal, V.K., Howard, R.J., and Savidov, N.A. 2004. Electrochemically activated (ECA) water: A new disease management tool for greenhouse vegetable crops. Annual Meeting of the Plant Pathology Society of Alberta, Lacombe, AB, November 8-10.

Goddard, T. and Woods, S.A.. 2004. Salinity mapping application for site specific management. In Proceedings of the 41st Alberta Soil Science Workshop, Lethbridge, AB. February 2004. p. 147-151.

Harding, M.W., Howard, R.J., Neeser, C., Strelkov, S.E., Tewari, J.P., Lisowski, S.L.I. Slomp, D.L. Xue, S., and Spencer, R.C.J. A survey for clubroot disease caused by *Plasmodiophora brassicae* on cruciferous vegetables across Alberta in 2004. Annual Meeting of the Plant Pathology Society of Alberta, Lacombe, AB, November 8-10.

Howard, R.J., Burke, D.A., Murray, C.L., Seymour, N.G., Slomp, D.L., and Spencer, R.C.J. 2004. Studies of black knot disease on Prunus species in Alberta, 2003-04. Olds College Horticulture Applied Degree Students' Tour, Brooks, AB, October 19.

Hwang S.F., Conner, R.L., Chang, K.F., Gossen, B.D. Su, H., Howard, R.J., and Turnbull, G.D. 2004. Seeding conditions: potential for management of mycosphaerella blight of field pea. Proceedings of the Fifth Canadian Pulse Research Workshop Proceedings, London, ON, November 29-30. P 33.

Hwang S.F., Conner, R.L, Chang, K.F., Turnbull, G.D., Blade, S.F., and Howard, R.J. 2004. Effects of seeding rate, seeding depth and seed condition on mycosphaerella blight and seed yield of field pea. Proceedings of the Agronomy Update Conference, Red Deer, AB, January 13-14.

Hwang, S.F., Conner, R.L., Chang, K.F., Turnbull, G.D., Su, H. Su, Gossen, B.D., Howard, R.J. and Blade, S.F. 2004. Effects of seeding depth and seed infection on mycosphaerella blight and seed yield of field pea. Proceedings of the Agronomy Update Conference, Red Deer, AB, January 13-14. P. 161.

Hingley, L and Woods, S.A. 2004. Soil salinity survey of the Crop Diversification Centre South, using electromagnetic induction and global positioning. In Proceedings of the 41st Alberta Soil Science Workshop, Lethbridge, AB. February. p. 260-264.

Kachanoski, R.G., Woods, S.A. and Dyck, M.F. 2004. Solute transport under semi-arid conditions: pedon to landscape scale. Presented at the 2004 Joint Annual Meetings of the American Society of Agronomy and the Canadian Society of Soil Science. Seattle, WA. November.

McKenzie, R.H. 2004. Optimizing winter cereal production with seeding rate, date, opener typeand slow release N fertilizer. Southern Alberta Conservation Association Conference, Medicine Hat, AB. Dec. 1. Pages 33-43.

Murray, C.L. 2004. Nursery Crops Research Update. Alberta Horticulture Congress. Nov 17.

Woods, S.A. and Hingley, L. 2004. Effects of soil salinity on potatoes. In Proceedings of the 41st Alberta Soil Science Workshop, Lethbridge, AB. February. p. 188-191.

Woods, S.A. and Hingley, L. 2004. Effects of frozen soil on electromagnetic inductance. In Proceedings of the 41st Alberta Soil Science Workshop, Lethbridge, AB. February. p. 199-202.

Woods, S.A., Dyck, M.F. and Kachanoski, R.G. 2004. Using conservative and pedogenic tracers to assess temporal variations in deep drainage on the Canadian Prairies. Presented at the 2004 Joint Annual Meetings of the American Society of Agronomy and the Canadian Society of Soil Science. Seattle, WA. November.

Yang, J., DiCarlo, A., Howard, R.J., Kharbanda, P.D., and Mirza, M. 2004. Internal fruit rot of greenhouse sweet pepper: A new disease in Alberta. Annual Meeting of the Plant Pathology Society of Alberta, Lacombe, AB, November 8-10.

Presentations at Industry Meetings

(Alberta Horticultural Congress; annual meetings of commodity organizations, AARI , producer groups and companies; workshops and open houses for growers, processors and agribusinesses)

Bandara, M. 2004. Effect of day length and night temperature on crop growth and flowering in four pulse crop species. 5th Canadian Pulse Research Workshop, London ON. Nov 30.

Bandara, M. 2004. Pulse Research Update. Alberta Pulse Growers Zone 1 Annual Meeting and Production Seminar. Taber AB. Dec 7.

Howard, R.J. 2004. Bacterial ring rot: Identification and management. Bacterial Ring Rot Inspectors' Workshop, Taber, AB, July 5.

Howard, R.J. 2004. Black currant disease update for 2003. Alberta Black Currant Producers' Network Meeting, Brooks, AB, January 13.

Howard, R.J. 2004. Black currant disease update for 2003. Prairie Natural Processing Annual Meeting, Red Deer, AB, March 11.

Howard, R.J. 2004. Black currant disease research update for 2004. Alberta Horticultural Congress, Edmonton, AB, November 19.

Howard, R.J. 2004. Comparative performance of fungicides against white mold on dry beans in Alberta in 2003. Alberta Pulse Growers Zone 1 Meeting, Taber, AB, January 19.

Howard, R.J. 2004. Controlling sclerotinia white mold on dry beans in southern Alberta. White Mold Action Meeting, Winnipeg, MB, November 17.

Howard, R.J. 2004. Diseases of greenhouse cucumbers and tomatoes. Saskatchewan Greenhouse and Vegetable Conference and Tradeshow, Saskatoon, SK, November 13.

Howard, R.J. 2004. Diseases of field peas and mustard. 2004 Southern Alberta Soil and Crop Diagnostic Field School, Lethbridge, AB, June 28-July 9.

Howard, R.J. 2004. Dry bean disease update. Agricore United Bean Grower Meetings, Burdett, AB, February 21, and Taber, AB, February 22.

Howard, R.J. 2004. Fusarium diseases: Impact and Management in Seed, Processing and Table Potatoes. Potato Growers of Alberta Annual Conference, Red Deer, November 18.

Howard, R.J. 2004. Greenhouse crop diseases. Alberta Horticultural Congress, Edmonton, AB, November 19.

Howard, R.J. 2004. Greenhouse vegetable diseases: Survey and research results for 2004. Greenhouse Crops Research Update Seminar, Redcliff, AB, December.

Howard, R.J. 2004. Managing diseases in greenhouse crops. Greenhouse Summer School, Olds, AB, July 22.

Howard, R.J., Burke, D.A., Murray, C.L., Seymour, N.G., Slomp, D.L. and Spencer, R.C.J. 2004. Occurrence of black knot on Prunus species in Alberta in 2003. Landscape Alberta Nursery Trades Association Growers' Group Meeting, Olds, AB, March 30.

Howard, R.J.. 2004. Pulse crop diseases in southern Alberta in 2004. Alberta Pulse Growers Zone 1 Annual Meeting, Taber, AB, December 7.

Howard, R.J. 2004. The top ten vegetable diseases on the Prairies. Saskatchewan Greenhouse and Vegetable Conference and Tradeshow, Saskatoon, SK, November 13.

Konschuh, M.N. and Dalpé, S. 2004. Timing of power hilling for Russet Burbank in southern Alberta – 1st year. Potato Growers of Alberta Breakfast Meeting, Taber, AB, March 19.

McKenzie, R.H. 2004. Malting Barley Research. Alberta Barley Commission Zone Meeting, Warner, AB. Nov. 4.

McKenzie, R.H. 2004. Winter Wheat Research. Southern Alberta Conservation Association Annual Meeting. Medicine Hat, AB. Dec. 1

McKenzie, R.H. 2004. Micronutrient requirements of crops. AgriValue Agronomy Meeting, Warner. Dec. 9

Najda, H. 2004. Highlights of the 5th International Herbage Seed Conference. Canadian Forage and Turf Seed Conference. Saskatoon, SK. January 12-14.

Najda, H.G. 2004. Studies on annual legume seed production under irrigation. Bow Island Substation Update. Bow Island, AB, July 27.

Najda, H.G. 2004. A forage seed visit to Oregon. Irrigated Alfalfa Seed Producers Association Fall Meeting. November 18.

Neeser, C. 2004. Integrated Management of Black Currants: a research update. Black Currant Network Meeting, Brooks, AB, January 13.

Neeser, C. 2004. What's in Fruit as a Functional Food, Berry School, Nisku, AB, February. 28.

Neeser, C. 2004. What's New in Pesticides. UFA Vegetable Grower Meeting, Lethbridge, AB, April 1.

Neeser, C. 2004. How to Apply Pesticides with a Backpack Sprayer. UFA Vegetable Grower Meeting, Lethbridge, AB, April 1.

Neeser, C. 2004. Nitrogen Fertilizer. UFA Vegetable Grower Meeting, Lethbridge, AB, April 1.

Woods, S.A. 2004. Salinity and Irrigated crop production issues. The Right Amount Conference on Irrigation Expansion – Risks and Rewards. Taber, AB. February 25.

Woods, S.A. 2004. Salinity and dryland crop production issues. Vulcan CAESA Salinity Workshop. Vulcan, AB. March 24.

Woods, S.A. and Hingley, L. 2004. Introduction of the soil and water agronomy program and EM38 demonstration for the CDD Meeting Tour. June 16, 2004.

Woods, S.A. 2004. Soil salinity in Southern Alberta. Lethbridge Diagnostic Field School. Lethbridge, AB. June 29-30.

Woods, S.A. 2004. Soil salinity and crop salinity tolerances lecture and field demonstration for University of Lethbridge Geography 4760 (Agricultural Soil Management) students. September 24.

Media Interviews

Bandara, M. 2004. Alternative speciality crops at Crop Diversification Centre South. Brooks and County Chronicle. March 29.

Jangula, S. 2004. Trip to Kazakhstan was positive experience. Brooks Bulletin. March 30.

Konschuh, M. 2004. Some new research at the Crop Diversification Centre South in Brooks may someday affect the way we view potatoes. Call of the Land. May 25.

Howard, R.J. 2004. Bronze Leaf Disease in Poplar. Q13. July 29.

Howard, R.J. 2004. New disease of poplar trees moving westward. Call of the Land. July 28.

McKenzie, R.H. 2004. Much needed moisture today. Call of the Land. May 11.

McKenzie, R.H. 2004. More tips on growing winter wheat. Call of the Land. August 19.

McKenzie, R.H. 2004. Growing winter wheat. Call of the Land. August 18.

McKenzie, R.H. 2004. Agronomy Update Interview. Nov. 19?

McKenzie, R.H. 2004. Winter wheat interview. Call of the Land. Dec. 1.

McKenzie, R.H. 2004. Fall fertilization; aired on Oct 29, 30 and 31. 2/7 Global TV

McKenzie, R.H. 2004. Agronomy Update meeting; aired on Oct 29, 30 and 31. 2/7 Global TV

McKenzie, R.H. 2004. Nutrient management; and Agronomy Update; 2/7 Global TV Farm TV on CFCN, Nov. 26

McKenzie, R.H. 2004. Winter Wheat production. Dec. 1

McKenzie, R.H. 2004. Ten tips for top Timothy production. Top Crop Manager

McKenzie, R.H. 2004. Replacing wheat in crop rotations. Bayer Magazine.

McKenzie, R.H. 2004. Growing 140 Bu soft wheat. Top Crop Manager –

McKenzie, R.H. 2004. Corn and manure go hand in hand. Top Crop Manager, Dec 2004.

McKenzie, R.H. 2004. Winter wheat production research. Western Producer.

Najda, H.G. 2004. Grass seed production a crop worth considering. Brooks Bulletin. March 30.

Najda, H.G. 2004. Bow Island Substation Field Day. Country 95 Radio, Lethbridge. July 13.

Najda, H.G. 2004. Five New Clover Varieties Being Tested for Seed Yield at Crop Diversification Centre South. Call of the Land. September 1.

Najda, H.G. 2004. Room for More Grass Seed Growers. Irrigating Alberta. Fall.

Savidov, N.A. 2004. Aquaponics: a ground breaking agricultural advance for the industry. Brooks and County Chronicle. March 29.

Woods. S.A. 2004. Soil salinity knowledge important for farmers. Brooks Bulletin. April 2.

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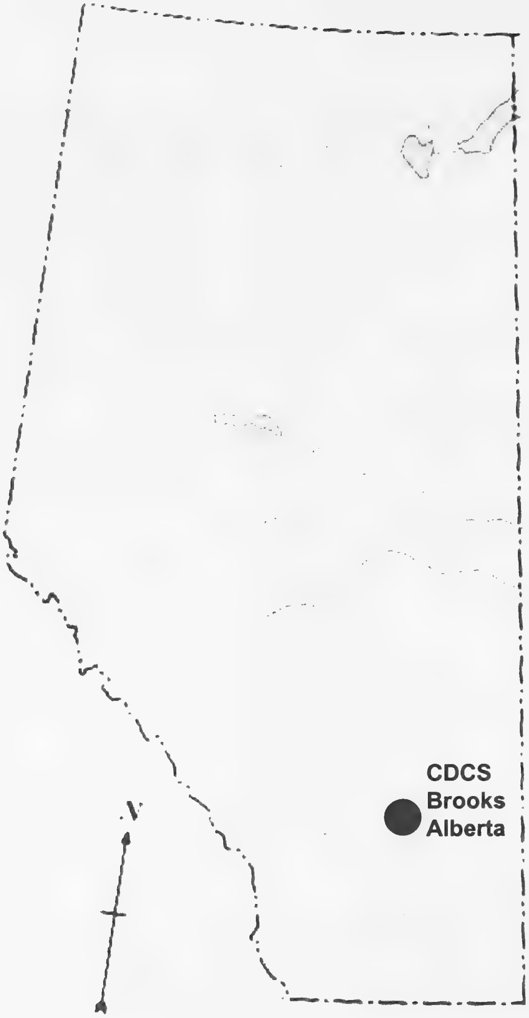
GLOSSARY

AAFC	Agriculture and Agri-Food Canada
AAFRD	Alberta Agriculture, Food and Rural Development
AARI	Alberta Agriculture Research Institute
AFFPA	Alberta Farm Fresh Producers Association
ARC	Alberta Research Council, Vegreville, AB
CDCN	Crop Diversification Centre North, Edmonton, AB
CDCS	Crop Diversification Centre South, Brooks, AB
GPS	Global Positioning System
MII	Matching Investment Initiative
U of A	University of Alberta
U of S	University of Saskatchewan

CDCS LOCATION



Crop Diversification Centre South Quick Facts

•surrounded by semi-arid short grass prairie

•site is 127 hectares (316 acres)

•winter temperatures as cold as -40°C (-40°F), but warm west winds (chinooks) can cause the temperature to rise 20 degrees in a few hours

•summer temperatures can reach 39°C (102°F)

•annual precipitation average 300 mm (12 inches), half can be rain in the growing season

•annual average 2,400 sunshine hours

•average growing season is 137 days

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